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On the cover: *Opopaea vohibazaha,* palp, anterior view.

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Systematics of the Goblin Spider Genus *Opopaea* (Araneae, Oonopidae) in Madagascar

Daniela Andriamalala
and Gustavo Hormiga

Bulletin of the American Museum of Natural History

SYSTEMATICS OF THE GOBLIN SPIDER GENUS *OPOPAEA* (ARANEAE, OONOPIDAE) IN MADAGASCAR

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ABSTRACT

The *Opopaea* fauna of Madagascar is documented for the first time. There are 27 species of *Opopaea* on the island of which 26 are newly described here and 25 are apparently endemic to Madagascar: *Opopaea andranomay,* n. sp., *O. ankarafantsika,* n. sp., *O. ankarana,* n. sp., *O. antsalova,* n. sp., *O. andringitra,* n. sp., *O. antsiranana,* n. sp., *O. bemarivo,* n. sp., *O. bemaraha,* n. sp., *O. berenty,* n. sp., *O. betioky,* n. sp., *O. itampolo,* n. sp., *O. kirindy,* n. sp., *O. manderano,* n. sp., *O. mahafaly,* n. sp., *O. manongarivo,* n. sp., *O. namoroka,* n. sp., *O. sandranantitra,* n. sp., *O. torotorofotsy,* n. sp., *O. tsimaloto,* n. sp., *O. tsimbazaza,* n. sp., *O. tsimembo,* n. sp., *O. tsinjoriaky,* n. sp., *O. tsingy,* n. sp., *O. vohibazaha,* n. sp., *O. foulpointe,* n. sp. and *O. maroantsetra,* n. sp. (shared with Kenya and the Comoros Islands), and *O. concolor* (Blackwall, 1859), a cosmopolitan species. All species are described and illustrated. An identification key to the species and maps of their distribution in Madagascar are also provided.

INTRODUCTION

Although *Opopaea* is one of the most diverse and widely distributed oonopid genera, we know surprisingly little about the overall diversity of this group in Madagascar. *Opopaea* currently consists of 50 valid species of which six are considered to be misplaced in the genus (Platnick, 2012). The genus is known from Africa, Madagascar and the surrounding islands, the Middle East (Israel, Egypt), Bhutan, Australia, Southeast Asia (Sri Lanka, the Philippines, China, Thailand), and the New World, although *Opopaea* has been hypothesized as introduced (nonnative) in the latter region. In fact, no native American species have been found (Platnick and Dupérré, 2009) and the only two species present in America are pantropical (*O. deserticola* Simon and *O. concolor* (Blackwall)). There are also several undescribed species from Africa and from Australia (http://research.amnh.org/oonopidae/).

Opopaea are found in virtually all parts of the former supercontinent Gondwanaland except New Zealand and Antarctica. The presence of cosmopolitan species such as *Opopaea deserticola* and *O. concolor* suggests that the genus may either be old and its oldest species were already distributed in those continents before the break up of Gondwanaland or that *Opopaea* may have a more complex history of vicariance associated with more recent dispersal due to human interference. Although the genus is very diverse, both in Africa and Australia, their phylogeny (Andriamalala and Hormiga, in prep.) suggests that *Opopaea* is most probably of African origin, as the two cosmopolitan species *Opopaea deserticola* and *O. concolor* are more closely related to the African species than to the Australian and Asian species. The *Opopaea* fauna of Madagascar was completely unknown before our work.

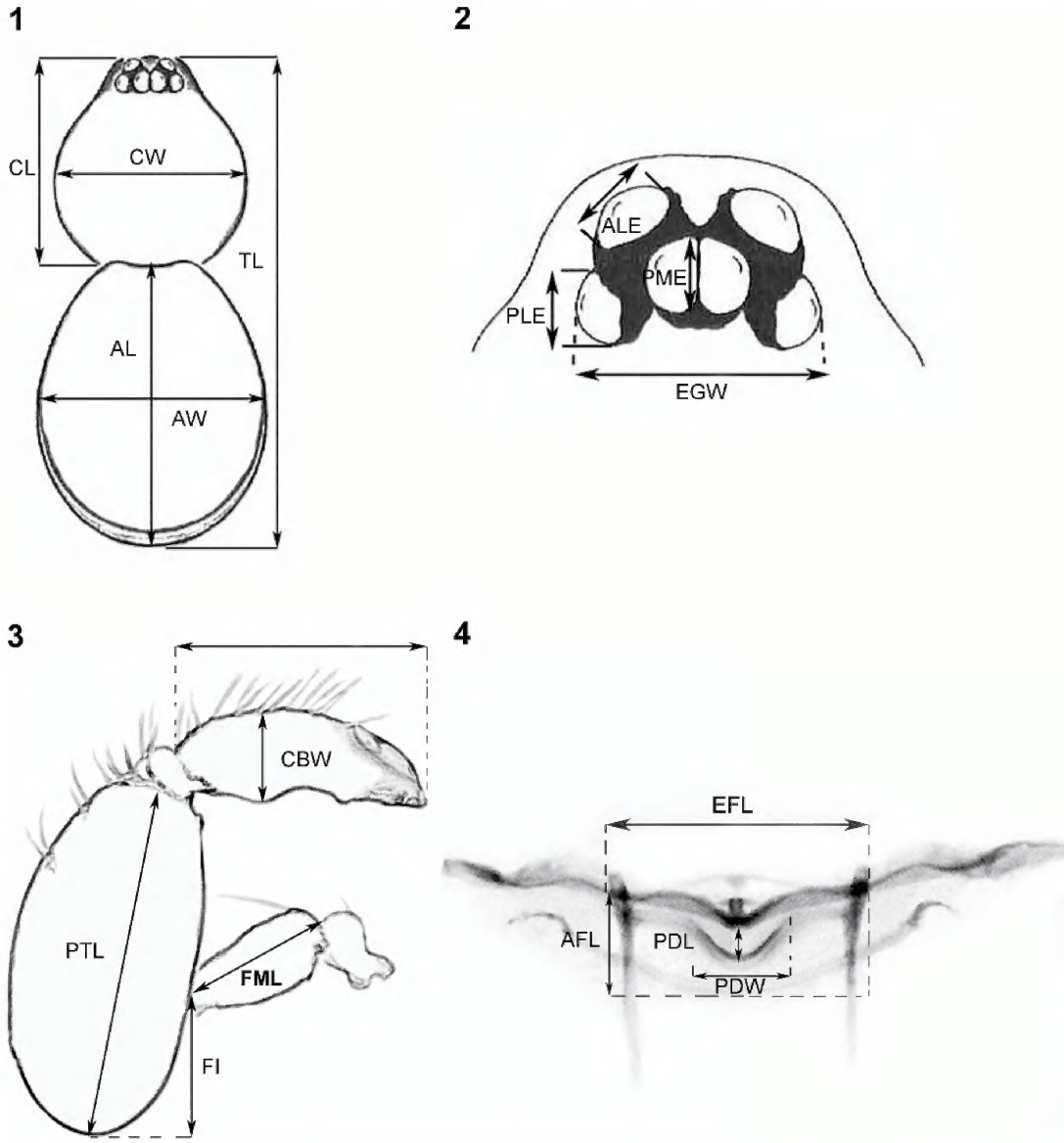
Opopaea are small to medium-sized oonopids, ranging from 1.0 to 2.4 mm in body length, with the abdomen completely covered with ventral and dorsal scuta. They belong to the "Loricatae" and "Opopaea group" (Saaristo, 2001). Their tarsal organ shows a pattern of 3-3-2-2 sensilla distribution, which places them within the subfamily Oonopinae (Platnick et al., 2012).

Although members of the genus *Opopaea* can be differentiated from other oonopid genera by a combination of characters (see Diagnosis section below), the circumscription of the genus is still ambiguous, in part because *Opopaea* also shares some but not all of these characters with other oonopid genera. For example, many genera, such as *Epectris* Simon (1893), *Camptoscaphiella* Caporiacco (1934), *Brignolia* Dumitrescu and Georgescu (1983), *Ischnothyreus* Simon (1893), *Malagiella* Ubick and Griswold (2011), and *Prethopalpus* Baehr et al. (2012), have sclerotized palps like those of *Opopaea* (Baehr and Ubick, 2010; Baehr et al., 2012; Kranz, 2011; Platnick and Duperré, 2010–2011). *Malagiella*, *Camptoscaphiella,* and *Prethopalpus* share with *Opopaea* the enlarged palpal patella also originating subbasally from the palpal femur, and in *Malagiella* the bulb and cymbium are also fused. The male palps of *Brignolia, Epectris,* and *Prethopalpus* have "fenestra" and the epigyna in these genera also have lateral apodemes as in *Opopaea*. In some species of

Brignolia, and *Epectris* there are also striations on the lateral side of the carapace. However, none of the six aforementioned genera have all these characters in combination like *Opopaea*. For instance, in the females of *Malagiella* and *Camptoscaphiella*, while the male palpal patella is greatly enlarged as in *Opopaea*, the abdomen is only partially covered by a scutum, the epigynum is completely different and have an external copulatory orifice (see Ubick and Griswold, 2011: figs. 5, 105), and the carapace has no striations on the lateral sides. In addition, *Camptoscaphiella* and *Prethopalpus* have the bulb and the cymbium separated rather than fused as in *Opopaea* and the pedicel with neither the small, dorsolateral, triangular extensions nor the paired curved scutal ridges as in all *Opopaea* species (Baehr and Ubick, 2010; Baehr et al., 2012). Although *Brignolia* and *Ischnothyreus* both have pitch-black and heavily sclerotized palps, they have a normal-sized papal patella. The female genitalia of *Ischnothyreus* are very different from those of *Opopaea*; the abdomen is only partially covered with a scutum and the tarsi with an elongated distal tooth on the claws of leg IV of females (see Ubick and Griswold, 2011: fig. 59). *Brignolia* and *Epectris* female genitalia are quite similar to that of *Opopaea*'s except for the presence in some species of a sclerotized structure of various forms (other than the parmula) in the area between the epigastric furrow and the groove joining the posterior spiracle, called here "postgynum nob". Externally this structure has a slit on its lateral sides and could constitute the copulatory openings in those genera (see Platnick et al., 2011: fig. 69; Platnick and Duperré, 2009: figs. 132, 149, 150, 159). Likewise, it is important to note that the lack of a "postgynum depression," a depression below the epigastric furrow (figs. 47–50) present in all *Opopaea* species, and the presence of a "posterior tubular process" (see Platnick et al., 2011: figs. 70, 71) also appear to differentiate *Brignolia* and *Epectris* from *Opopaea*. *Epectris,* which was previously placed within *Opopaea* as *O. lena* Suman, resembles *Opopaea* the most in overall somatic characters and could be *Opopaea* sister taxa. In fact, *Epectris* was erected as a new genus by Saaristo and Marusik (2008) based on the alleged absence of a palpal fenestra (a depression at the tip of the male palp; figs. 194, 226, 258, 290, 326, 357, 415), but later, Platnick and Duperré (2010) discovered the presence of the fenestra in *Epectris* palps (see Platnick and Duperré, 2009: figs. 153, 154). However, the palpal fenestra in *Epectris* and *Brignolia* differs from those of *Opopaea* as it is rather a depression instead of a hole.

Because of the aforementioned confusion about the generic limits, combined with *Opopaea*'s almost cosmopolitan distribution, numerous species have been transferred in and out of *Opopaea* and several species from different parts of the world have been synonymized after revisionary treatments. For example, some species that clearly belong to *Opopaea* were initially described in *Gamasomorpha* Karsch (1881), and numerous species have been mistakenly assigned to *Opopaea*. Recently, in a revision of the New World *Opopaea*, *O. devia* Gertsch from Texas, *O. guaraniana* Birabén from Argentina, and *O. bandina* Chickering from Florida as well as *Myrmecoscaphiella borgmeyeri* Mello-Leitão from Brazil were all synonymized with *Opopaea concolor*, while *O. timida* Chickering, from Panama, was placed as a junior synonym of *O. deserticola* (Platnick and Duperré, 2009).

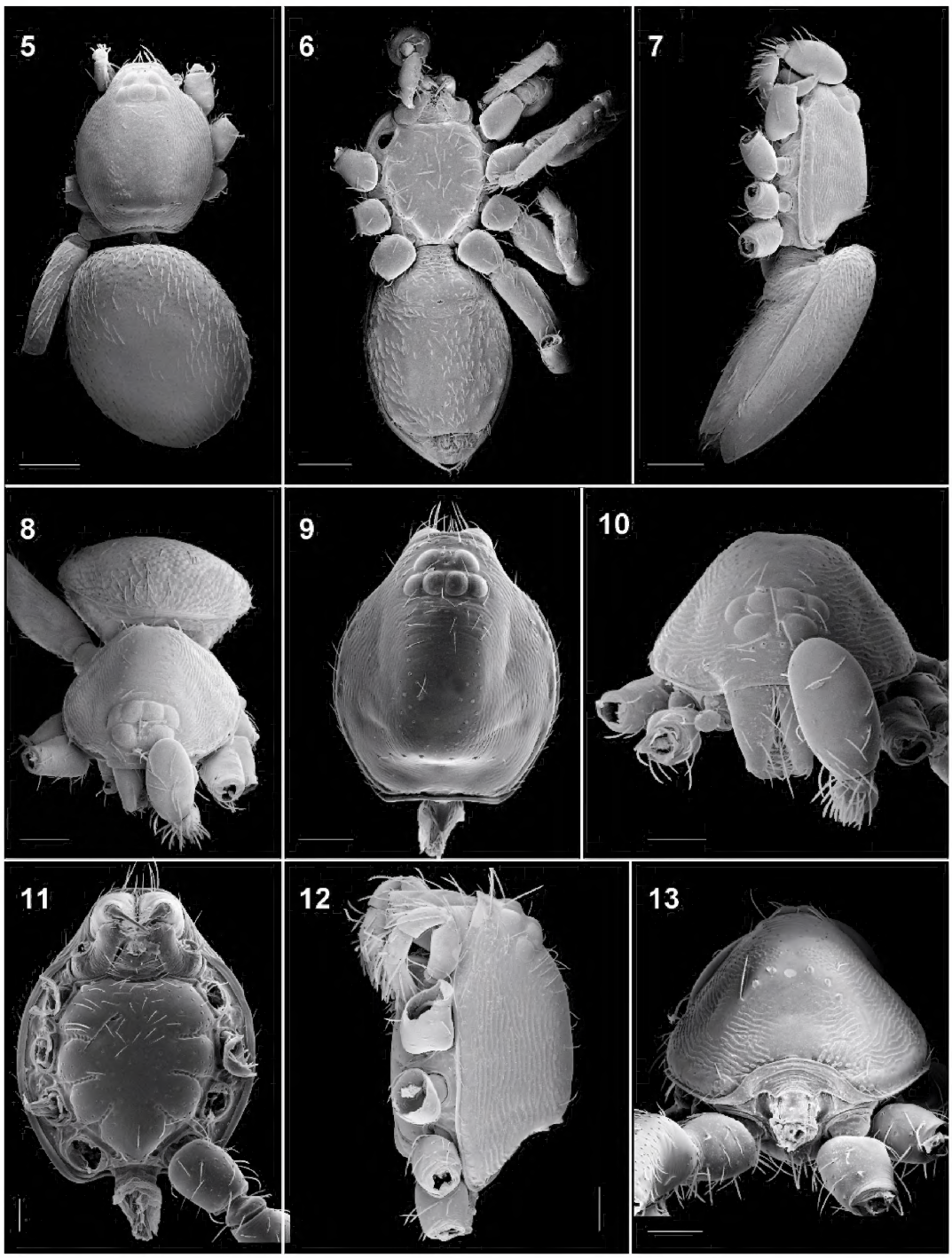
The *Opopaea* fauna from remote places rich in biodiversity like Madagascar is currently unknown. Malagasy organisms are known for their remarkable species richness and endemism (Goodman and Benstead, 2003; Griswold, 2003). Here, we describe the first *Opopaea* species from this island. Examination of museum collections and recent collections, including our own fieldwork in Madagascar, have revealed 27 *Opopaea* species of which 26 are new. In the last three years, five new species have been discovered from Africa (Saaristo and Marusik, 2008), seven from China (Tong and Li, 2010), and eight from Australia (Baehr, in press). Currently, there are 50 described species of *Opopaea* (Platnick, 2012). Many more may be discovered and some may need to be synonymized. Therefore, the genus needs to be revised and the species relationships within *Opopaea* need to be clarified in a phylogenetic framework.



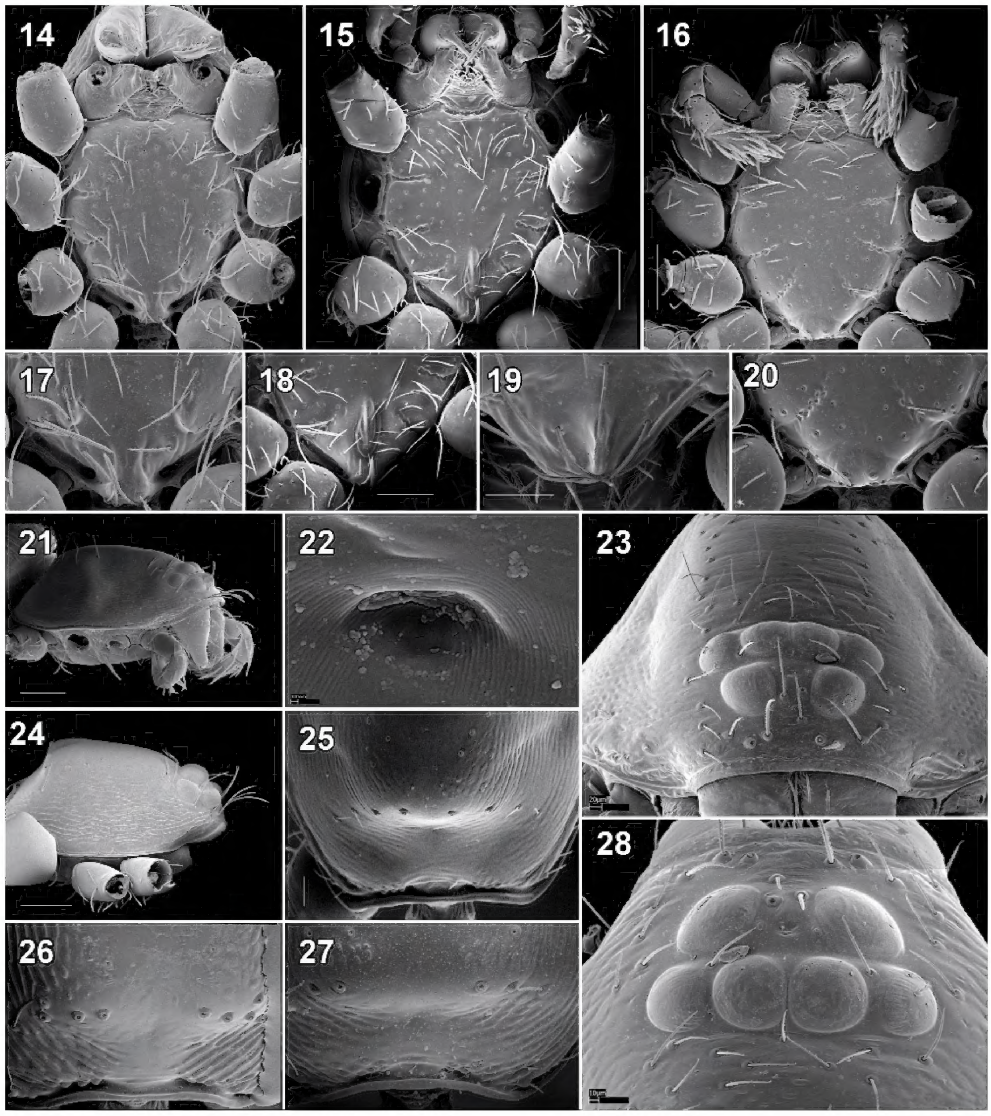
Figs. 1–4. Measurements. **1.** *Opopaea* sp., dorsal view. **2.** Eye region, dorsal view. **3.** Palp, prolateral view. **4.** Epigynum, dorsal view. Abbreviations: **AL,** abdomen length; **AW,** abdomen width; **CL,** carapace length; **CW,** carapace width; **TL,** total length.

METHODS

This project is part of the goblin spider Planetary Biodiversity Inventory (http://research.amnh.org/oonopidae/), an effort to describe the goblin spiders (Oonopidae) of the world, including those from high-priority biodiversity hotspots like Madagascar (Mittermeier et al., 1997, 1999, 2004). More than 4000 *Opopaea* specimens from 67 localities in Madagascar have been collected by the Madagascar arthropod project carried out by the California Academy of Sciences (CASC) Entomology Department in collaboration with the Botanical and Zoological Park of Tsimabazaza (PBZT) (2000–2004) and the PBI project expedition (2009). Additional specimens were borrowed from



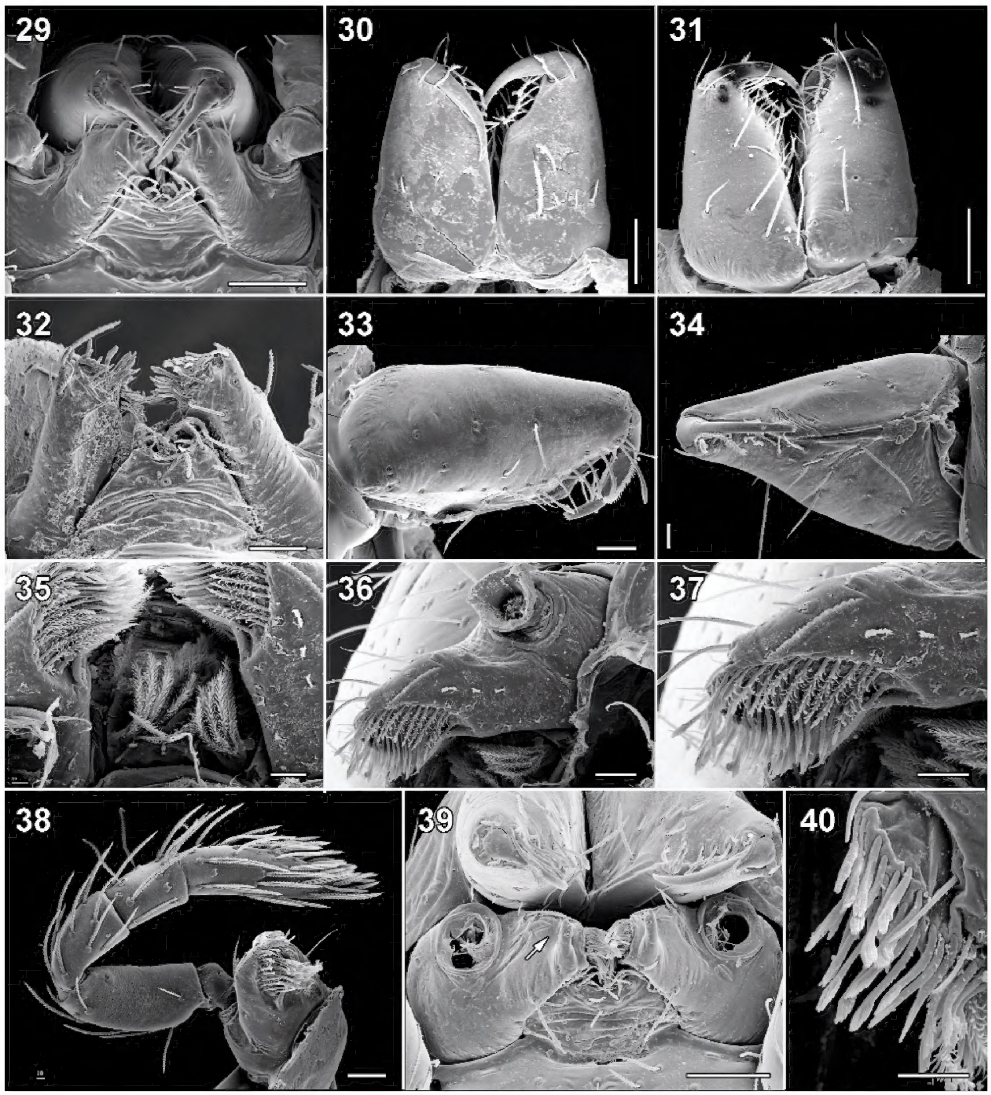
Figs. 5–13. **5.** *Opopaea manderano,* n. sp. Habitus, dorsal view. **6.** *Opopaea tsimembo,* n. sp. Habitus, ventral view. **7.** *Opopaea antsalova,* n. sp. Habitus, lateral view. **8.** Habitus, anterior view. **9.** *Opopaea andringitra,* n. sp. Carapace, dorsal view. **10.** *Opopaea namoroka,* n. sp. Carapace, anterior view. **11.** *Opopaea ankarafantsika,* n. sp. Carapace, ventral view. **12.** Carapace, lateral view. **13.** *Opopaea antsiranana,* n. sp. Carapace, posterior view. Scale bars: 100 μm.



Figs. 14–28. **14.** *Opopaea foulpointe,* n. sp. Sternum, ventral view. **15.** *Opopaea antsiranana,* n. sp. Sternum, ventral view. **16.** *Opopaea namoroka,* n. sp. Sternum, ventral view. **17.***Opopaea foulpointe,* n.sp. Sternum posterior part, ventral view. **18.** *Opopaea antsiranana,* n. sp. Sternum posterior part, ventral view. **19.** *Opopaea ankarana,* n. sp. Sternum posterior part, ventral view. **20.** *Opopaea namoroka,* n. sp. Sternum posterior part, ventral view. **21.** *Opopaea betioky,* n. sp. Carapace, lateral view. **22.** *Opopaea andringitra,* n. sp. Fovea, dorsal view. **23.** Carapace, anterior view. **24.** *Opopaea ankarana,* n. sp. Carapace, lateral view. **25.** *Opopaea andringitra,* n. sp. Carapace, posterior denticles, dorsal view. **26.** *Opopaea foulpointe,* n. sp. Carapace, posterior denticles, dorsal view. **27.** *Opopaea manderano,* n. sp. Carapace, posterior denticles, dorsal view. **28.** *Opopaea andringitra,* n. sp. Eyes, anterior view. Scale bars: figures 14–16, 17–20, 21–24 = 100 μm; figures 22, 25–27 = 40 μm; figure 23 = 20 μm; figure 28 = 10 μm.

the Royal Museum for Central Africa in Tervuren (MRAC), the American Museum of Natural History in New York (AMNH), the Field Museum of Natural History in Chicago (FMNH), and the Museum of Comparative Zoology at Harvard University (MCZ).

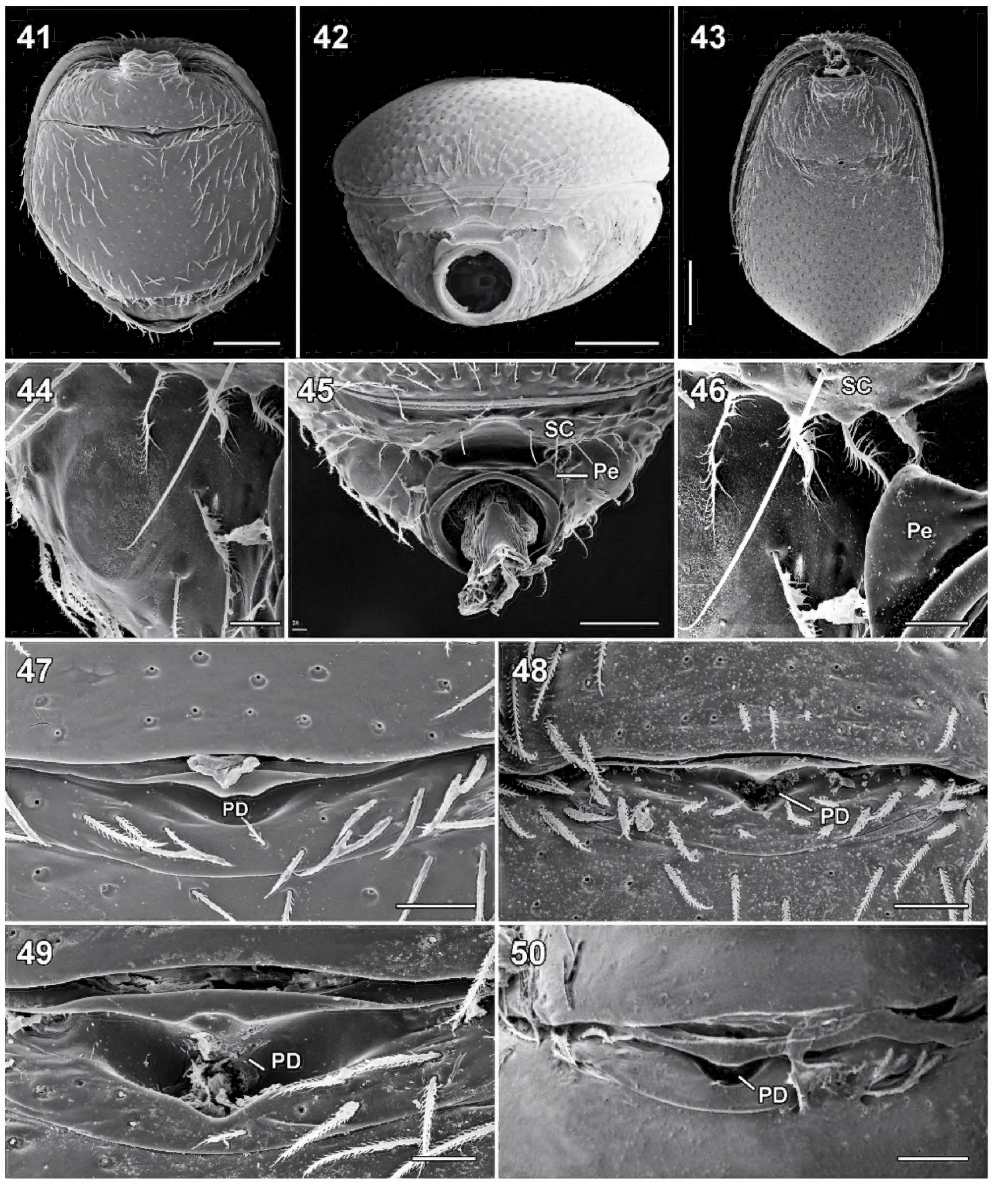
These samples encompass the diversity of the genus *Opopaea* in Madagascar as those surveys were conducted in more than 100



Figs. 29–40. **29.** *Opopaea antsiranana,* n. sp. Endites and labium, ventral view. **30.** *Opopaea ankarafantsika,* n. sp. Chelicerae, ventral view. **31.** Chelicerae, dorsal view. **32.** *Opopaea betioky,* n. sp. Endites and labium, anterior view. **33.** *Opopaea andringitra,* n. sp. Left chelicerae, dorsal view. **34.** Left chelicerae, mesal view. **35.** Endites and labium, anterior view. **36.** Right endite, dorsal view. **37.** Right endite, dorsal, close view. **38.** Female palp, prolateral view. **39.** *Opopaea foulpointe,* n. sp. Endites with tooth like projection, labium, anterior view. **40.** *Opopaea andringitra,* n.sp. Left endite hair tuft, ventral view. Scale bars: figures 29, 30, 31, 32, 35 = 100 μm; figure 36 = 40 μm; others = 20 μm.

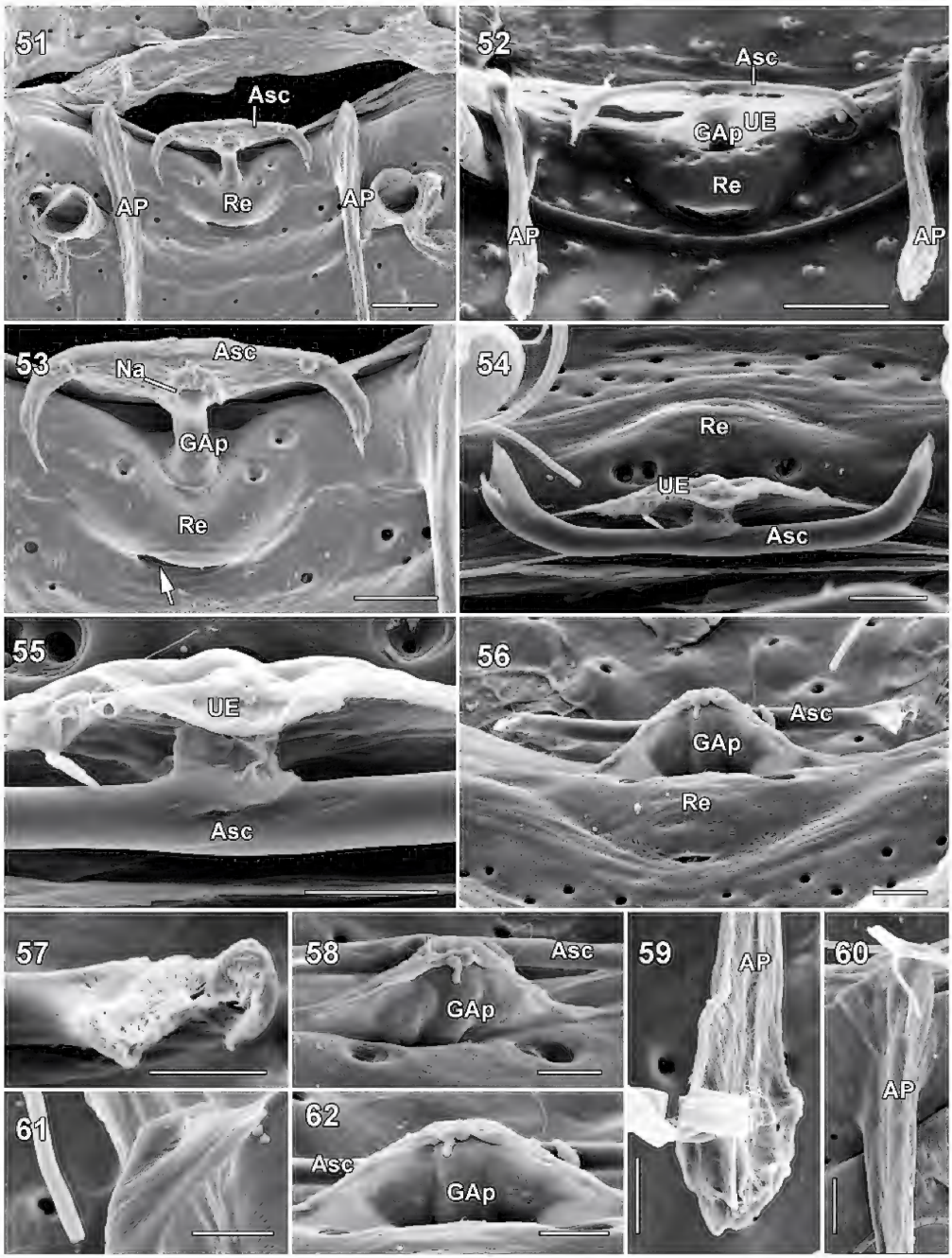
sites of varied vegetation, climate, elevation, and geological substrate in which different collecting methods (Winkler extractors and leaf-litter sifting, beating low vegetation, Berlese funnels, general collecting, and pitfall traps) were used to sample terrestrial arthropods (Fisher, 2005).

Morphological characters and locality data were used to discriminate species. We used the phylogenetic species concept sensu Wheeler and Platnick (2000) to hypothesize *Opopaea* species circumscription, that is, "the smallest aggregation of populations diagnosable by a unique combination of character

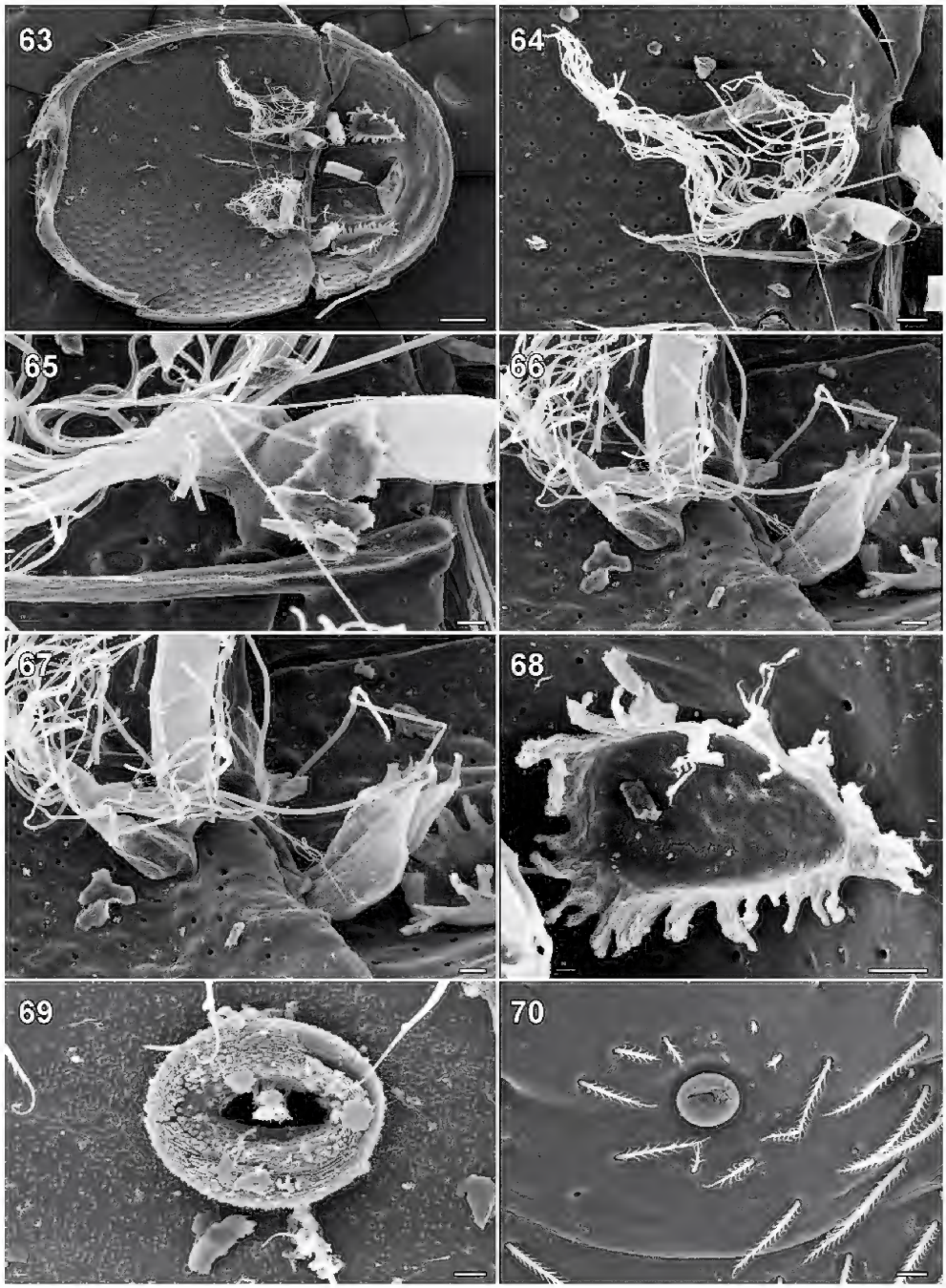


Figs. 41–50. **41.** *Opopaea namoroka,* n. sp. Female abdomen, ventral view. **42.** *Opopaea antsalova,* n. sp. Male abdomen, anterior view. **43.** *Opopaea tsinjoriaky,* n. sp. Male abdomen, ventral view. **44.** *Opopaea andringitra,* n. sp. Booklung cover, anterior view. **45.** Scutal ridges, anterior view. **46.** Special hairs near scutal ridge, anterior view. **47.** *Opopaea namoroka,* n. sp. Epigynum, ventral view. **48.** *Opopaea manderano,* n. sp. Epigynum, ventral view. **49.** *Opopaea ankarana,* n. sp. Epigynum, ventral view. **50.** *Opopaea tsimaloto,* n. sp. Epigynum, ventral view. Scale bars: figures 41, 42, 43, 45 = 20 μm; others = 10 μm.

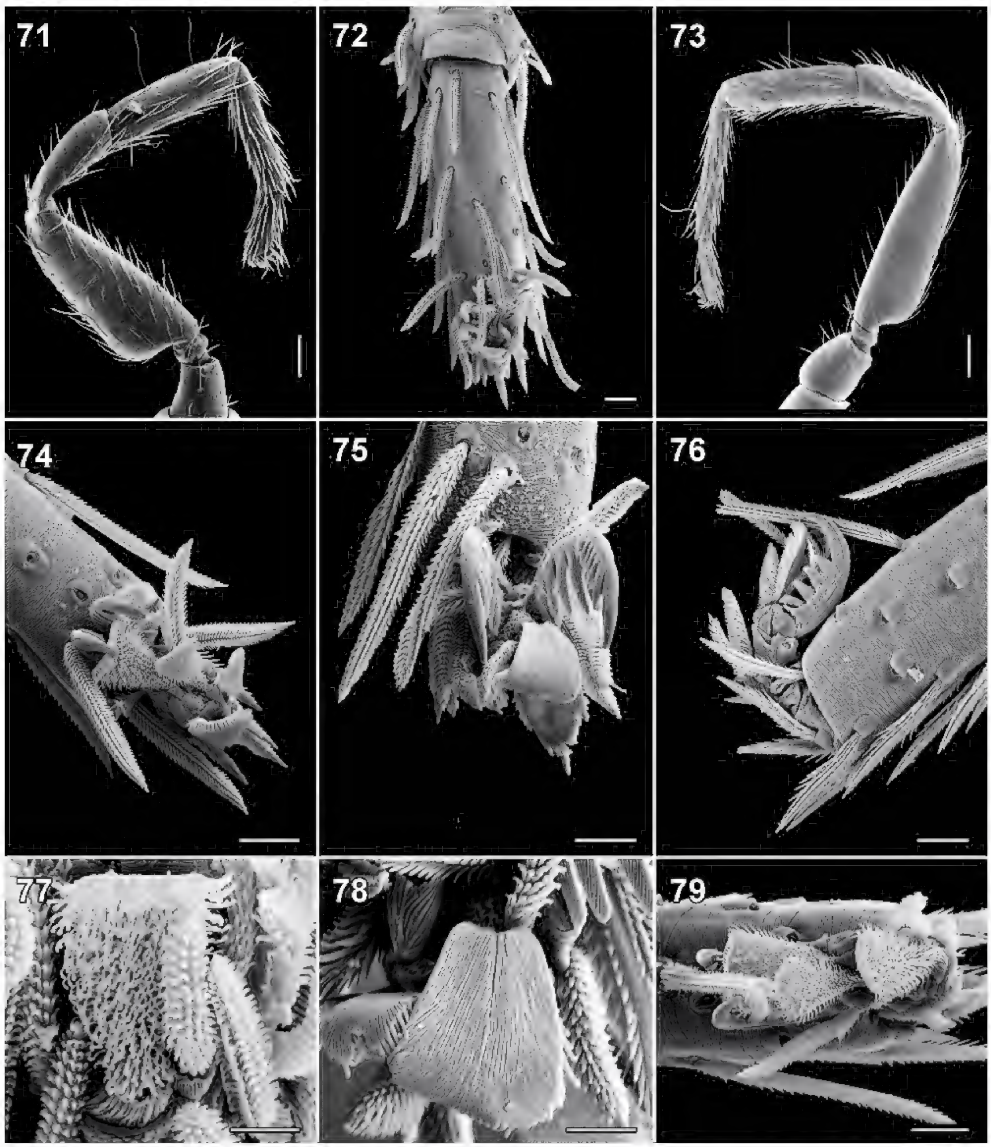
states." The male and female of each species, if both are known, are described. Species descriptions, illustrations, and measurements are based on five representative specimens of each species and sex whenever possible. Adult individuals representing the full range in overall size are chosen according to the degree of character variation and site locality to maximize the range of variation and geographic distribution considered. Descriptions were generated with the aid of the Planetary Biodiversity Inventory (PBI)



Figs. 51–62. **51.** *Opopaea tsimembo,* n. sp. Epigynum, dorsal view. **52.** *Opopaea tsimaloto,* n. sp. Epigynum, dorsal view. **53.** *Opopaea tsimembo,* n. sp. Epigynum, dorsal, close up. **54.** *Opopaea andringitra,* n. sp. Epigynum, apical view. **55.** Epigynum, sclerotized naillike structure. **56.** Epigynum, posterior. **57.** Epigynum, tip of the paddlelike structure of the anterior sclerite. **58.** Epigynum, posterior, close up. **59.** Epigynum, posterior tip of the right apodeme. **60.** Base of the left apodeme. **61.** Tip of the paddlelike structure. **62.** Base of the uterus externus, posterior view. Scale bars: 20 μm. Abbreviations: **AP,** apodeme; **Asc,** anterior sclerite; **GAp,** globular appendix; **Na,** naillike structure; **Re,** receptaculum.



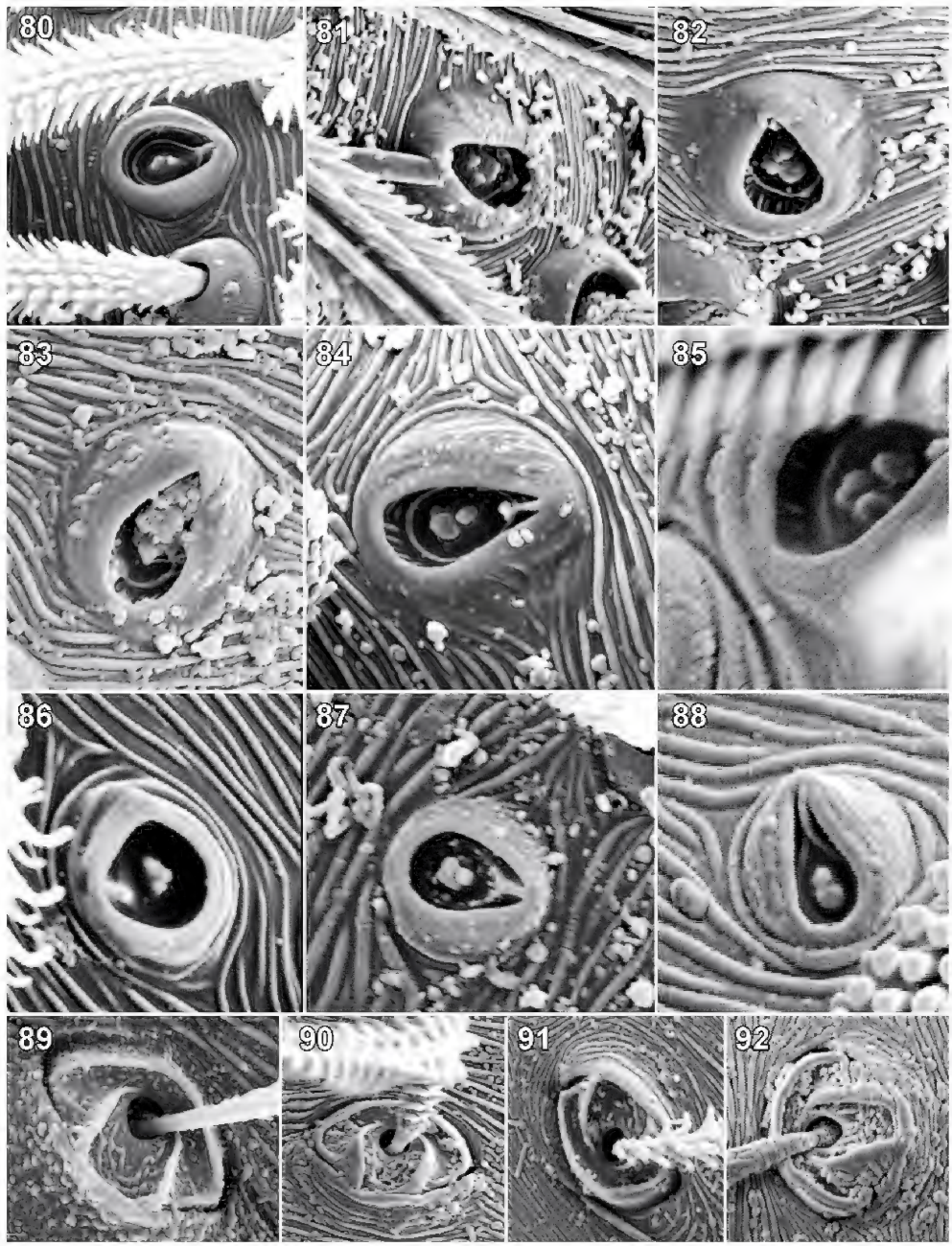
Figs. 63–70. **63.** *Opopaea andringitra,* n. sp. Internal male abdomen, dorsal view. **64.** Tracheal spiracle, dorsal view. **65.** Magnified view showing tracheal spiracles connection and base of apodeme. **66–67.** Tracheal spiracle connection, dorsal, close up. **68.** Booklung cover, dorsal view. **69.** Sperm pore, ventral view. **70.** *Opopaea namoroka,* n. sp. Sperm pore, ventral view. Scale bars: figures 63 = 100 μm; others = 20 μm.



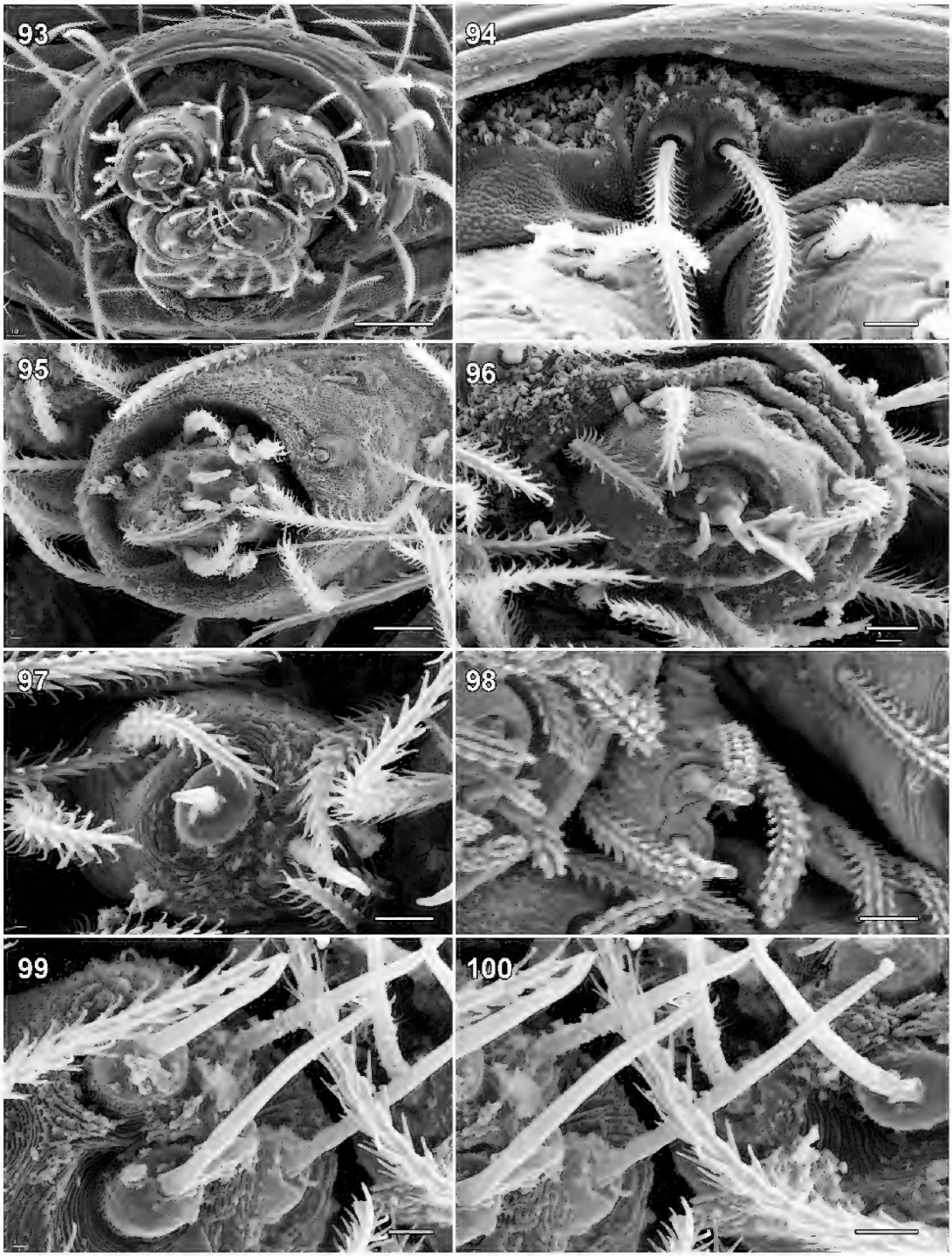
Figs. 71–79. **71.** *Opopaea andringitra,* n. sp., male. Left leg IV, prolateral view. **72.** Left tarsus I, dorsal view. **73.** Left leg IV, retrolateral view. **74.** *Opopaea antsalova,* n. sp., male. Left tarsus IV, dorsal view. **75.** Anterior view. **76.** Retrolateral view. **77.** *Opopaea andringitra,* n. sp., male. Left tarsus I, claw tufts, ventral view. **78.** Dorsal view. **79.** Left tarsus IV, claws, ventral view. Scale bars: figures 67, 69 = 100 μm; others = 10 μm.

descriptive goblin spider database and shortened whenever possible. All measurements are expressed in millimeters (figs. 1–4), and were taken using the measurement module of Leica Application Suite in a Leica MZ16 stereomicroscope. Size measurements were taken of males and females of each species, whenever possible, and are reported as ranges for each sex. In some species, there are fewer than five individuals available, so only those numbers are reported.

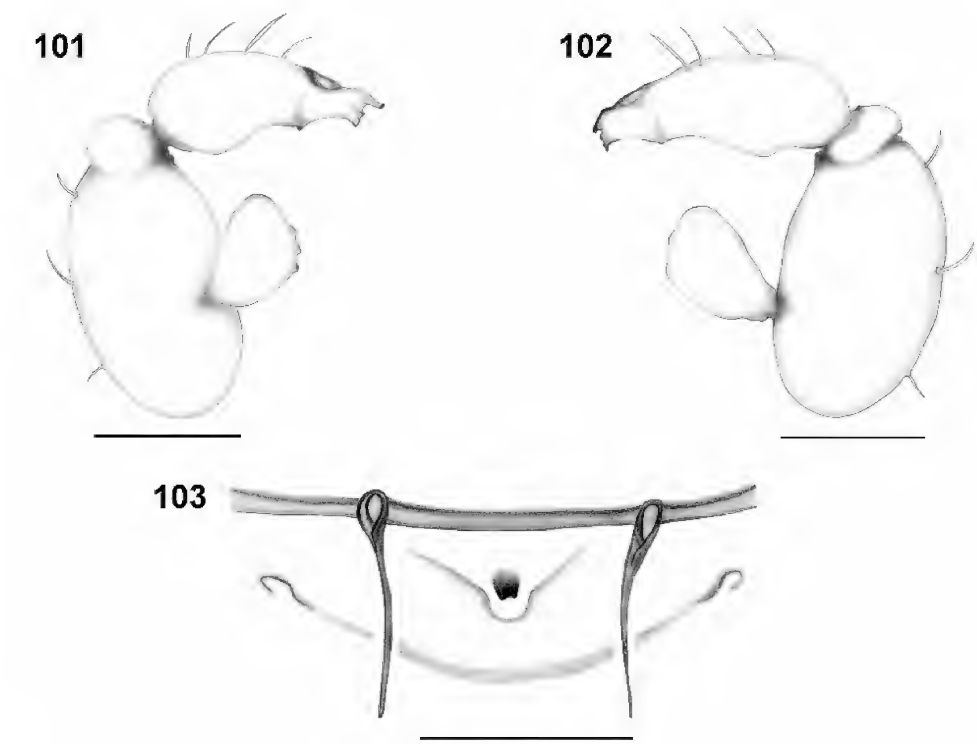
Specimens were examined using a Leica MZ APO and illustrated with a Leica MZ16 stereomicroscope with a Leica DFC 500 digital camera. SEM micrographs were taken with a LEO 143OVP scanning electron



Figs. 80–92. **80.** *Opopaea ankarafantsika,* n. sp. Palp, tarsal organ, dorsal view. **81.** *Opopaea antsalova,* n. sp. Leg I, tarsal organ, dorsal view. **82.** Leg II, tarsal organ, dorsal view. **83.** Leg III, tarsal organ, dorsal view. **84.** Leg IV, tarsal organ, dorsal view. **85.** *Opopaea maroantsetra,* n. sp. Palp, tarsal organ, dorsal view. **86.** *Opopaea tsinjoriaky,* n. sp. Palp, tarsal organ, dorsal view. **87.** *Opopaea torotorofotsy,* n. sp. Palp, tarsal organ, dorsal view. **88.** *Opopaea tsimembo,* n. sp. Palp, tarsal organ, dorsal view. **89.** *Opopaea andringitra,* n. sp. Metatarsi l, trichobothria, dorsal view. **90.** *Opopaea antsalova,* n. sp. Tibia II, trichobothria, dorsal view. **91.** Tibia I, trichobothria, dorsal view. **92.** Tibia III, trichobothria, dorsal view. Scale bars: 2 μm.



Figs. 93–100. **93.** *Opopaea andringitra,* n. sp., male. Spinnerets, posterior view. **94.** Collulus. **95.** Right ALS. **96.** Left ALS. **97.** Right PMS. **98.** *Opopaea ankarana,* n. sp., female, right PMS, posterior view. **99.** *Opopaea andringitra,* n. sp., male, right PLS, posterior view. **100.** Left PLS. Scale bars: figure 93 = 10 μm, others = 3 μm.

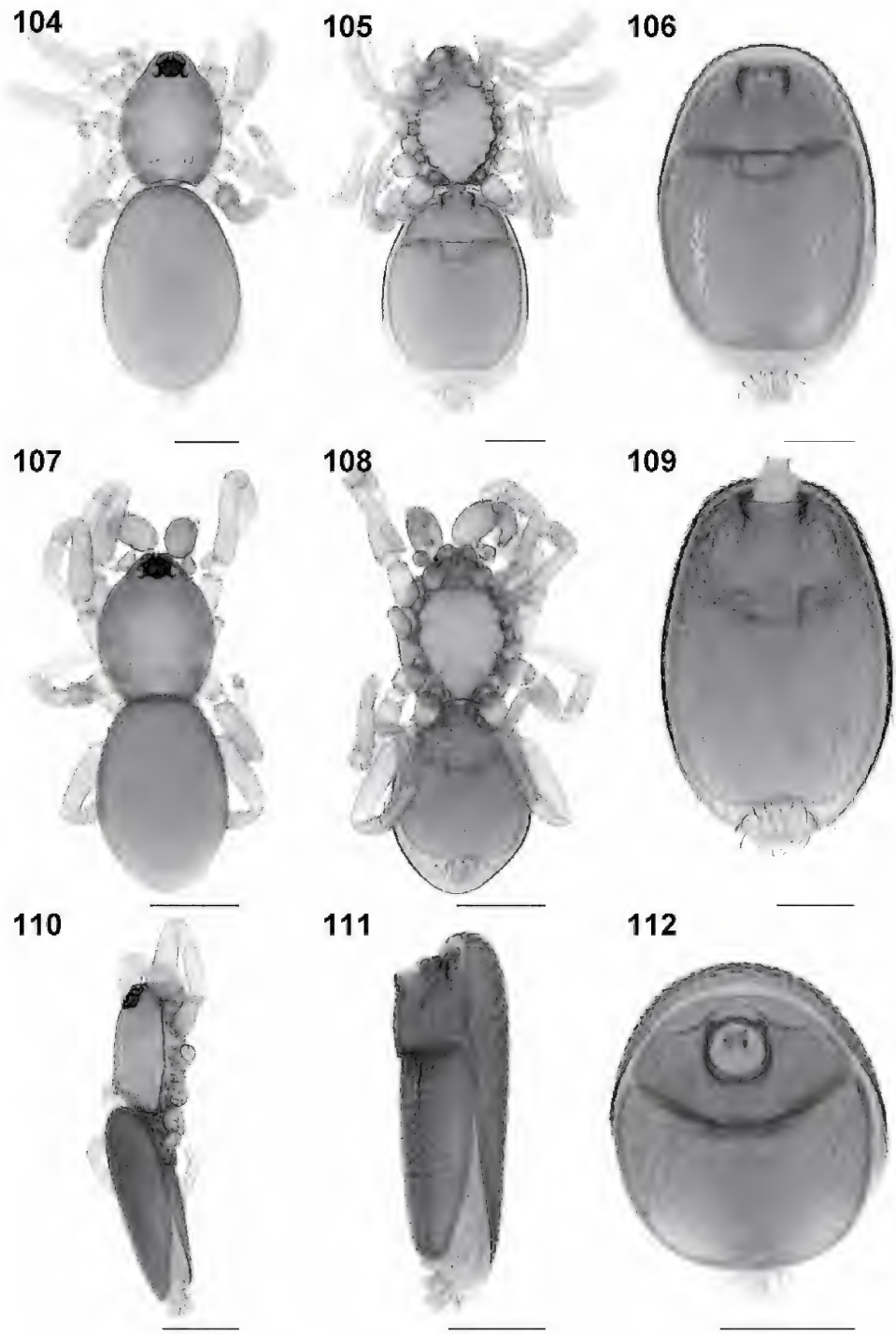


Figs. 101–103. *Opopaea concolor* (Blackwall). **101.** Palp prolateral view. **102.** Retrolateral view. **103.** Epigynum, dorsal view. Scale bars: 0.1 mm.

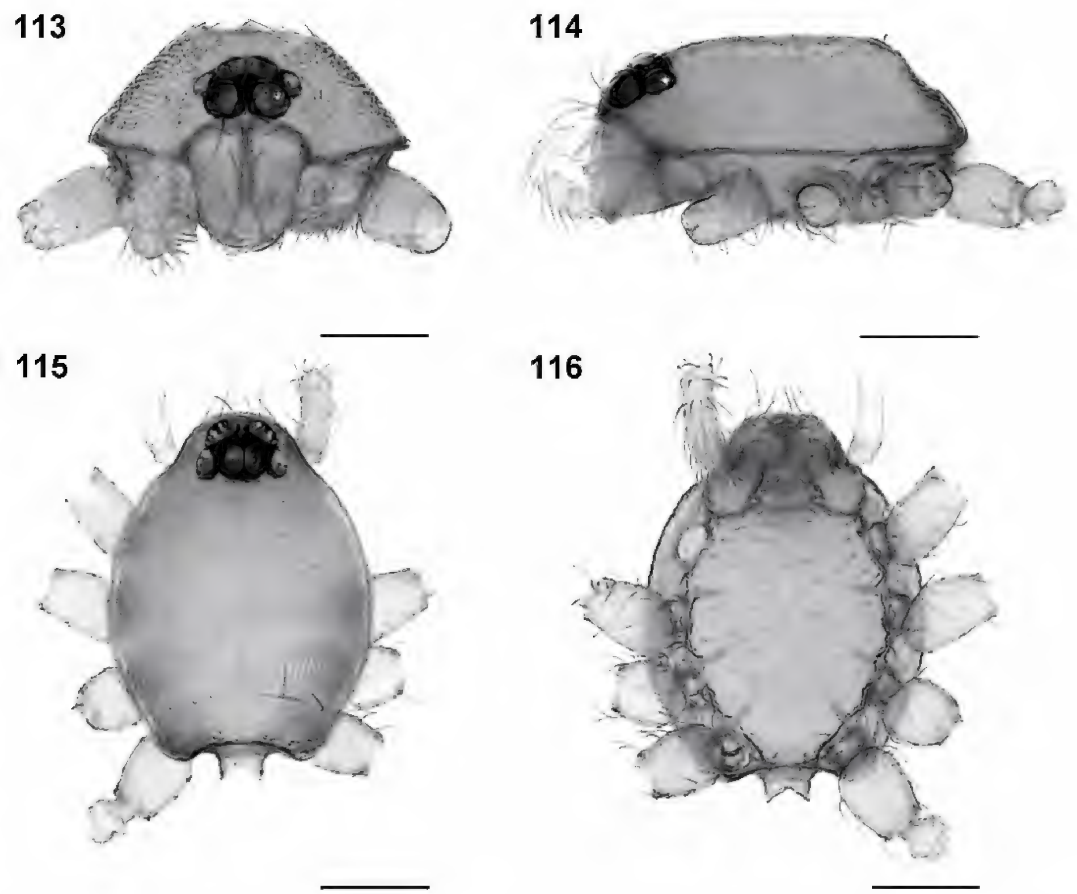
microscope. Specimens were dissected and cleaned ultrasonically before being transferred to 100% ethanol, and left to dehydrate for 24 hours. After dehydration, the specimens were critically point dried, mounted, and sputter coated with gold. For transmitted light microscopy, the specimens were made transparent by transferring them to methyl salicylate for a few minutes. Subsequently, the specimen was mounted in a microscope slide with a cover slip (see Grandjean, 1949) and examined/illustrated using an OLYMPUS BX51 compound microscope with a camera lucida. Specimens were drawn with graphite pencils and the drawings were scanned and further edited in Photoshop using a Bamboo Wacom tablet. For the male palp illustrations, the left palp was used. Female genitalia and tracheal system were dissected, and the soft tissue was digested with pancreatin enzyme complex (P1750 from Sigma-Aldrich; Alvarez and Hormiga, 2008). After removing any remaining tissues with a needle and forceps, the preparations were washed with distilled water and transferred to 75% ethanol for observation and illustration. Distribution maps were generated with the software DIVA-GIS (Elith et al., 2006). Distribution of suitable areas and climatic requirements for the genus in Madagascar were modeled from 93 *Opopaea* presence points taken from *Opopaea* occurrence data in Madagascar (after redundant points were removed), based on 20 environmental variables—altitude and 19 bioclimatic variables from WorldClim (30 arcsine seconds spatial resolution; Hijmans et al., 2005)—and using the software MAXENT (Philips and Dudik, 2008).

COLLECTIONS EXAMINED

AMNH	American Museum of Natural History, New York
CAS	California Academy of Sciences, San Francisco
FMNH	Field Museum of Natural History, Chicago



Figs. 104–112. *Opopaea concolor* (Blackwall). 104–106. Female. **104.** Habitus, dorsal view. **105.** Ventral view. **106.** Abdomen, ventral view. Male. 107–112. **107.** Habitus, dorsal view. **108.** Ventral view. **109.** Abdomen, ventral view. **110.** Habitus, lateral view. **111.** Abdomen, lateral view. **112.** Abdomen, anterior view. Scale bars: 0.2 mm.



Figs. 113–116. *Opopaea concolor* (Blackwall), female. **113.** Carapace, anterior view. **114.** Carapace, lateral view. **115.** Carapace, dorsal view. **116.** Carapace, ventral view. Scale bars: 0.2 mm.

MRAC	Royal Museum for Central Africa, Tervuren, Belguim
BNHM	Natural History Museum, London
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts

All other abbreviations used in the text and figures are listed in table 1.

SYSTEMATICS

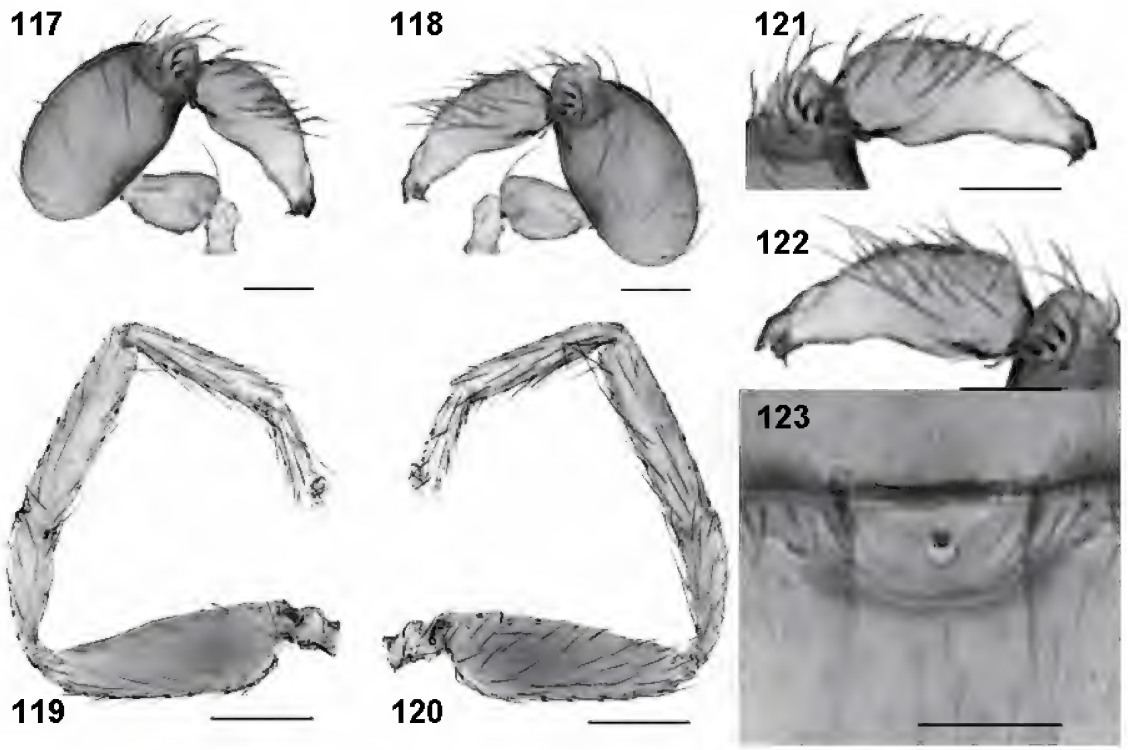
Family Oonopidae Simon, 1890
Opopaea Simon, 1891

Opopaea Simon, 1891: 560 (type species by monotypy *Opopaea deserticola* Simon).

DIAGNOSIS: Members of the genus *Opopaea* can be differentiated from those of other oonopid genera with fully fused sclerotized palps and with an enlarged palpal patella originating subbasally from the palpal femur (such as *Camptoscaphiella*, *Epectris*, *Malagiella* and *Prethopalpus*) by the following combination of characters present all at once:

(1) Male palps completely sclerotized with a greatly enlarged palpal patella that often originates subbasally from the palpal femur, a completely fused cymbium and bulb (cymbiobulbus), and a palpal fenestra as a cavity, not a depression like the one found in *Brignolia* and *Epectris* (figs. 3, 224, 226); endites with a toothlike projection (figs. 29, 39); and only posterior spiracles connected by a groove (figs. 143, 175).

(2) Females have various kinds of external genital structures (parmula) attached to their epigastric furrow; a depression in the epigastric region below the epigastric furrow (postgynum

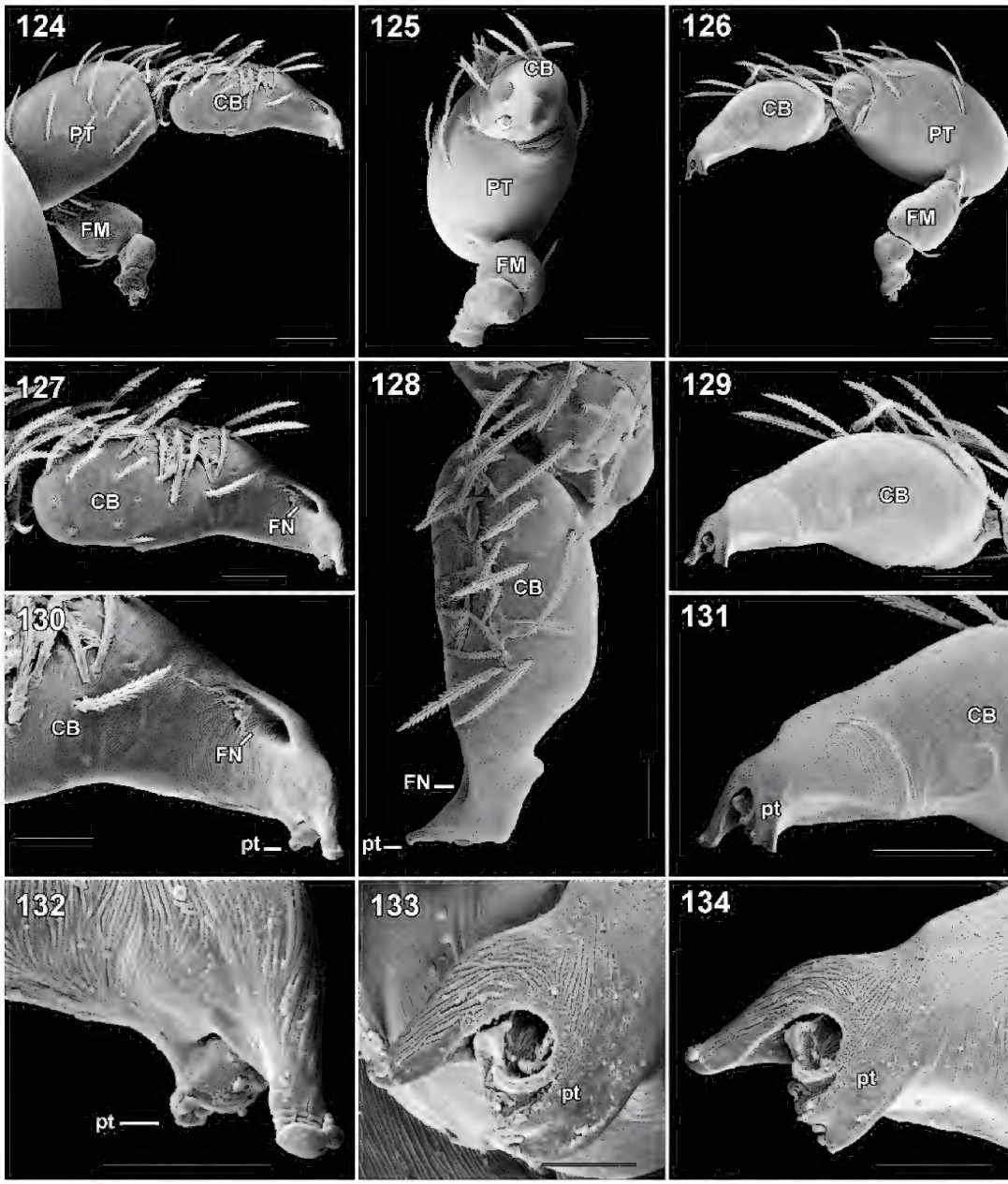


Figs. 117–123. *Opopaea concolor* (Blackwall). **117.** Male, palp, prolateral view. **118.** Retrolateral view. **119.** Leg four, prolateral view. **120.** Retrolateral view. **121.** Male, palp close up, prolateral view. **122.** Retrolateral view. **123.** Female, epigynum, dorsal view. Scale bars: figures 119, 120 = 0.2 mm; others = 0.1 mm.

depression; Saaristo, 2001; Saaristo and Marusik, 2008) (figs. 4, 47, 48, 807, 808); and lack of an elongated distal tooth on the claws of leg IV (figs. 74, 75, 76).

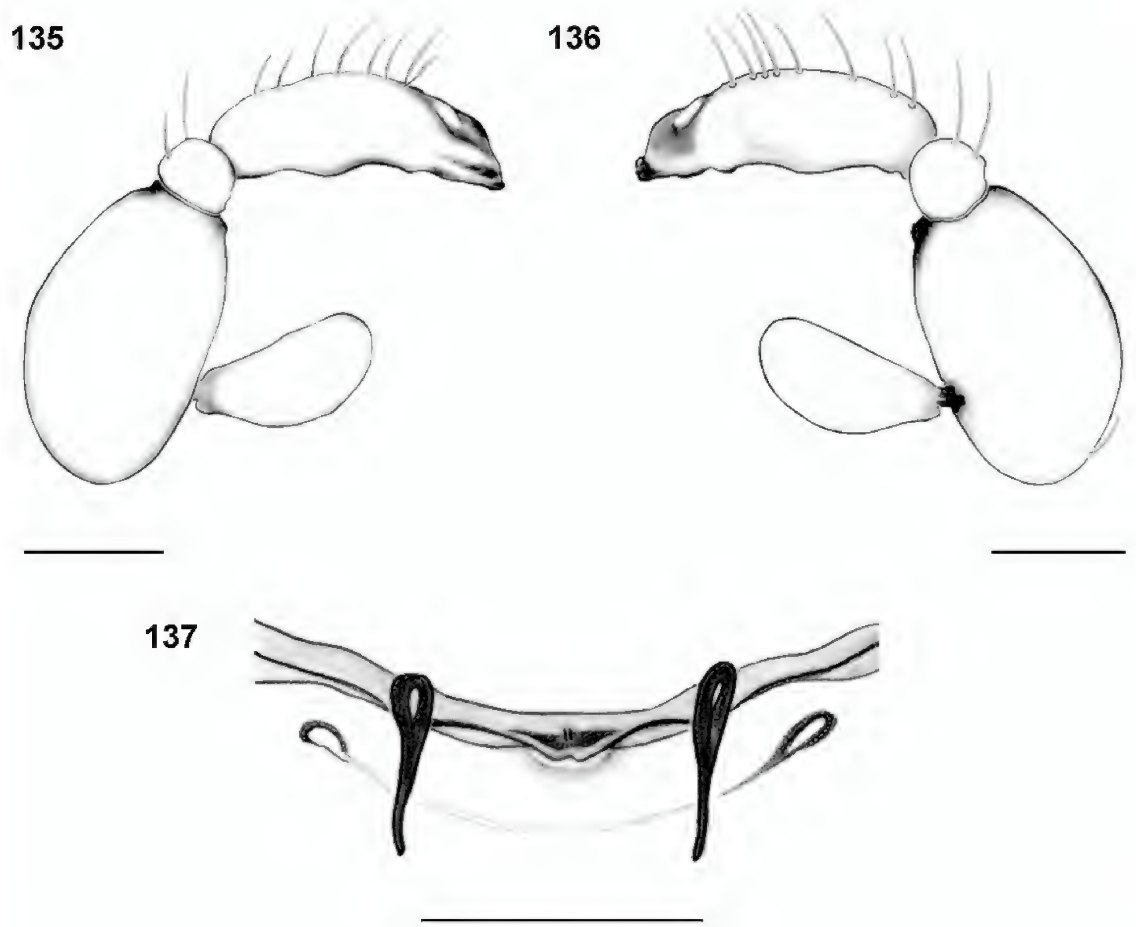
(3) Both sexes have: lateral striations on the carapace (figs. 9, 10, 12, 13); smooth sternum surface (figs. 11, 14, 15, 16); abdomen completely covered dorsally and ventrally with scuta; long and thin lateral apodemes that extend past the posterior spiracles (figs. 457, 460); pedicel tube with a pair of small dorsolateral, triangular extensions; and a pair of curved scutal ridges on the scutopedicel region (figs. 42, 45, 146, 211).

DESCRIPTION: Male: Total length: 1.02–2.14. **Cephalothorax:** Carapace without any pattern, posterolateral edge without pits, posterior margin not bulging below posterior rim, anterolateral corners without extension or projections, posterolateral surface without spikes, thorax without depressions, fovea absent, without radiating rows of pits; lateral margin straight; nonmarginal pars thoracica setae needlelike. Clypeus: median projection absent. Eyes: six, well developed. Sternum longer than wide, uniform, median concavity absent, smooth with radial furrows between coxae I–II, II–III, III–IV, anterior margin unmodified, posterior margin not extending posteriorly of coxae IV, anterior corner unmodified, extensions of precoxal triangles absent, lateral margins between coxae III unmodified. Mouthparts: chelicerae anterior face unmodified; without teeth on both promargin and retromargin; fangs without toothlike projections, shape normal, without prominent basal process, tip unmodified; setae needlelike; paturon distal region unmodified, posterior surface unmodified, promargin unmodified, inner margin unmodified. Labium sclerotization as in sternum. Endites distally not excavated, serrula present in a single row, posteromedian part unmodified, same as sternum in sclerotization. **Abdomen:** Without long posterior extension, rounded posteriorly, interscutal



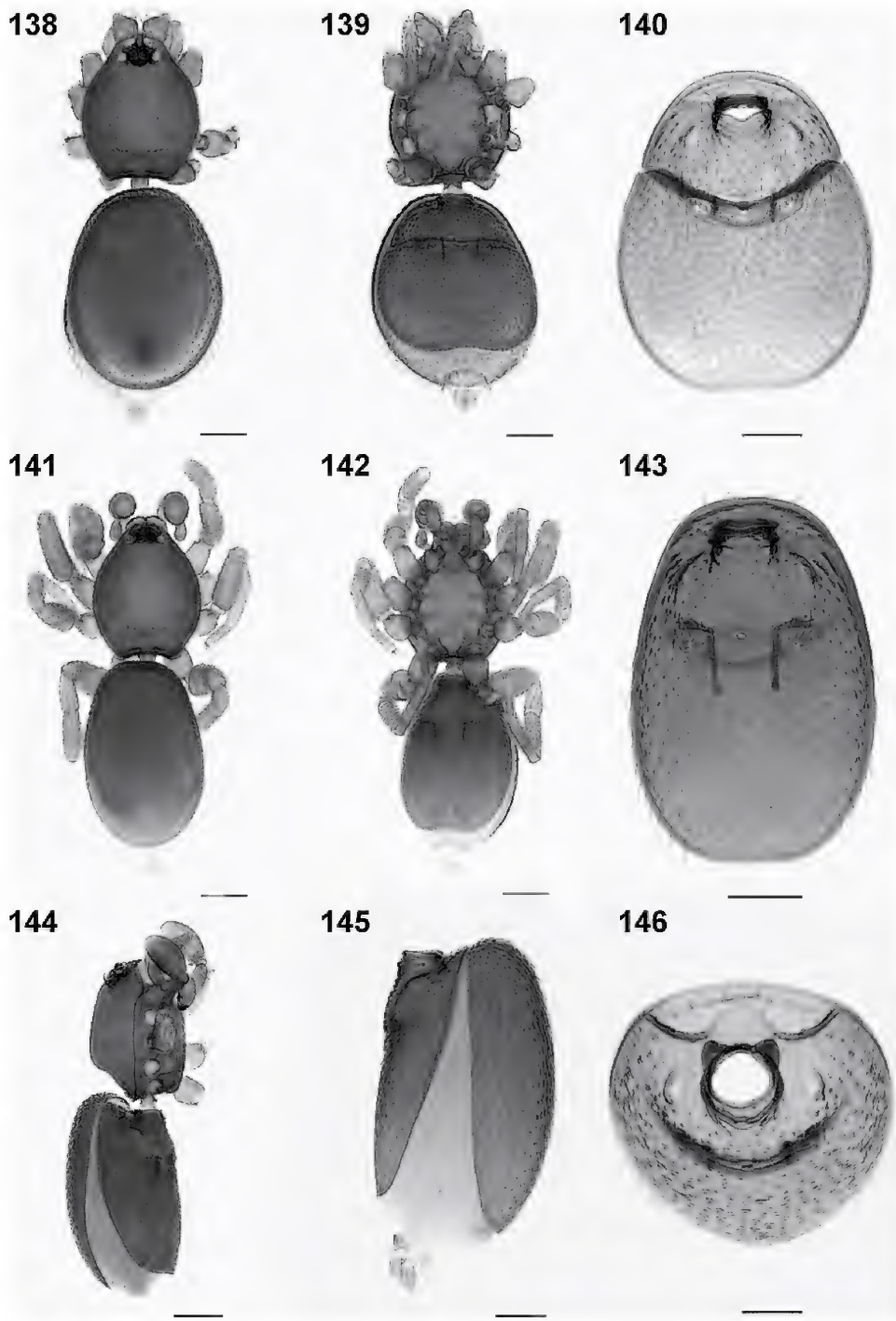
Figs. 124–134. *Opopaea concolor* (Blackwall), male palp. **124.** Prolateral view. **125.** Anterior view. **126.** Retrolateral view. **127, 130.** Prolateral, close up. **128.** Dorsal view. **129, 131.** retrolateral, close up. **132.** Embolar region, prolateral view. **133.** Anterior view. **134.** Retrolateral view. Scale bars: figures 124–126 = 60 μm; figures 127–129 = 95 μm; figures 130–134 = 115 μm. Abbreviations: **CB,** cymbiobulbus; **FM,** femur; **PT,** patella; **pt,** palp tip.

membrane rows of small sclerotized platelets absent posteriorly; dorsum soft portions without color pattern. Booklung covers without setae. Posterior spiracles connected by groove. Pedicel tube short with a pair of dorsolateral, triangular extensions, scutum not extending far dorsal of pedicel, matted setae on anterior ventral abdomen in pedicel

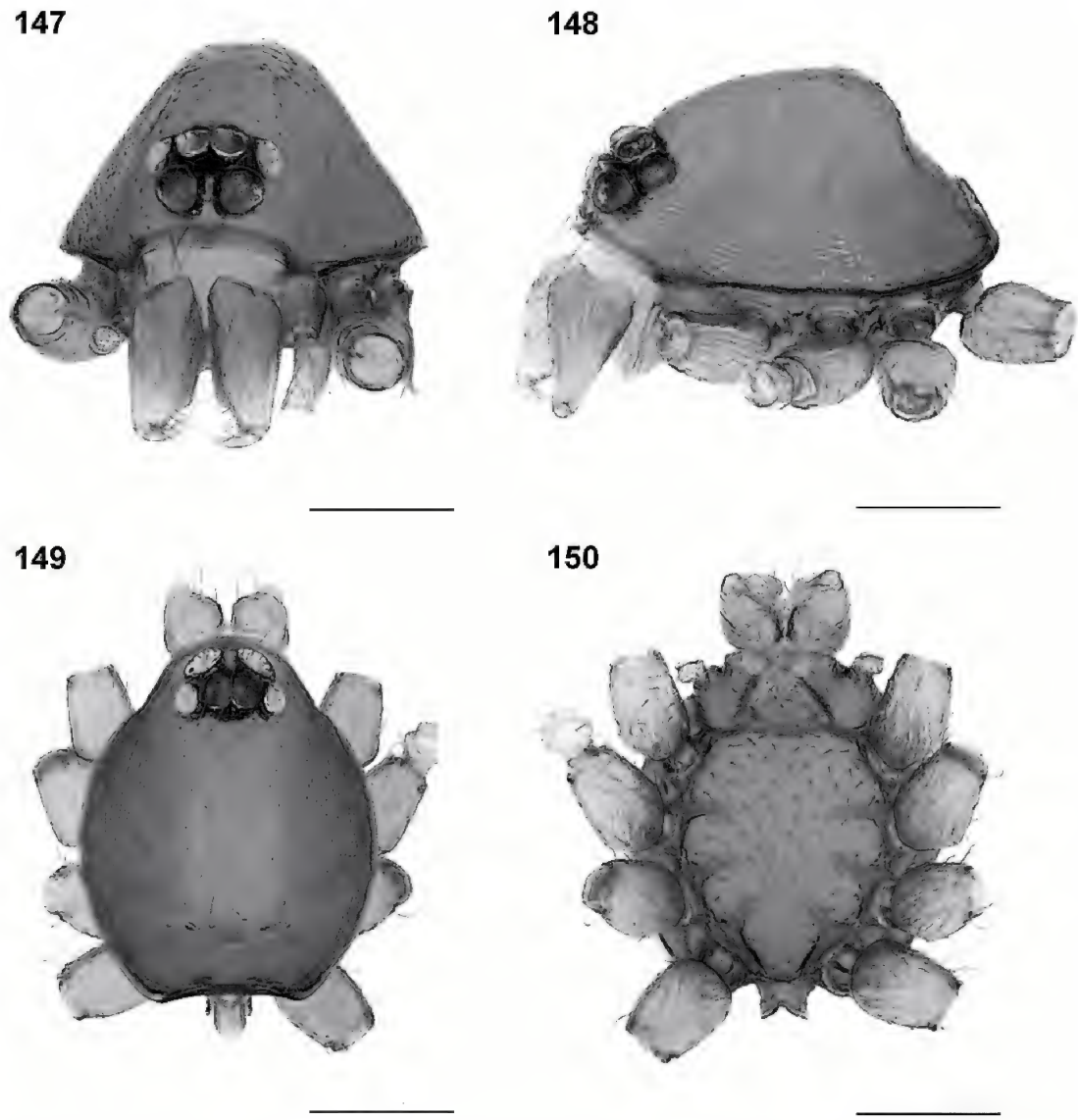


Figs. 135–137. *Opopaea andranomay,* n. sp. **135.** Male, palp prolateral view. **136.** Retrolateral view. **137.** Epigynum, dorsal view. Scale bars: 0.1 mm.

area absent, cuticular outgrowths near pedicel absent. Epigastric scutum strongly sclerotized, not protruding, small lateral sclerite absent. Postepigastric scutum strongly sclerotized, covering nearly full length of abdomen, anterior margin unmodified. Spinneret scutum present, incomplete ring, with fringe of needlelike setae, supraanal scutum absent, dense patch of setae anterior to spinnerets absent. Anterior lateral spinnerets (ALS) with single major ampullate gland spigot and one to two piriform gland spigots, posterior medians (PMS) with one to two minor ampullate gland spigots, posterior laterals (PLS) with one minor ampullate and two to three aciniform gland spigots. Epigastric area setae uniform, needlelike. **Legs:** Without spines, femur IV not thickened, same size as femora I–III, patella plus tibia I shorter than carapace, tibia I unmodified, tibia I Emerit's glands absent, tibia IV ventral scopula absent, metatarsi I and II mesoapical comb absent, metatarsi III and IV weak ventral scopula absent, tarsal proclaws and retroclaws inner face striate; tarsus I superior claws with one tooth on lateral surface of proclaw, five teeth on median surface of proclaw, one tooth on lateral surface of retroclaw, five teeth on median surface of retroclaw; tarsus II superior claws with one tooth on lateral surface of proclaw, five teeth on median surface of proclaw, one tooth on lateral surface of retroclaw, five teeth on median surface of retroclaw; tarsus III superior claws with one tooth on lateral surface of proclaw, four teeth on median surface of proclaw, one tooth on lateral surface of retroclaw, four teeth on median

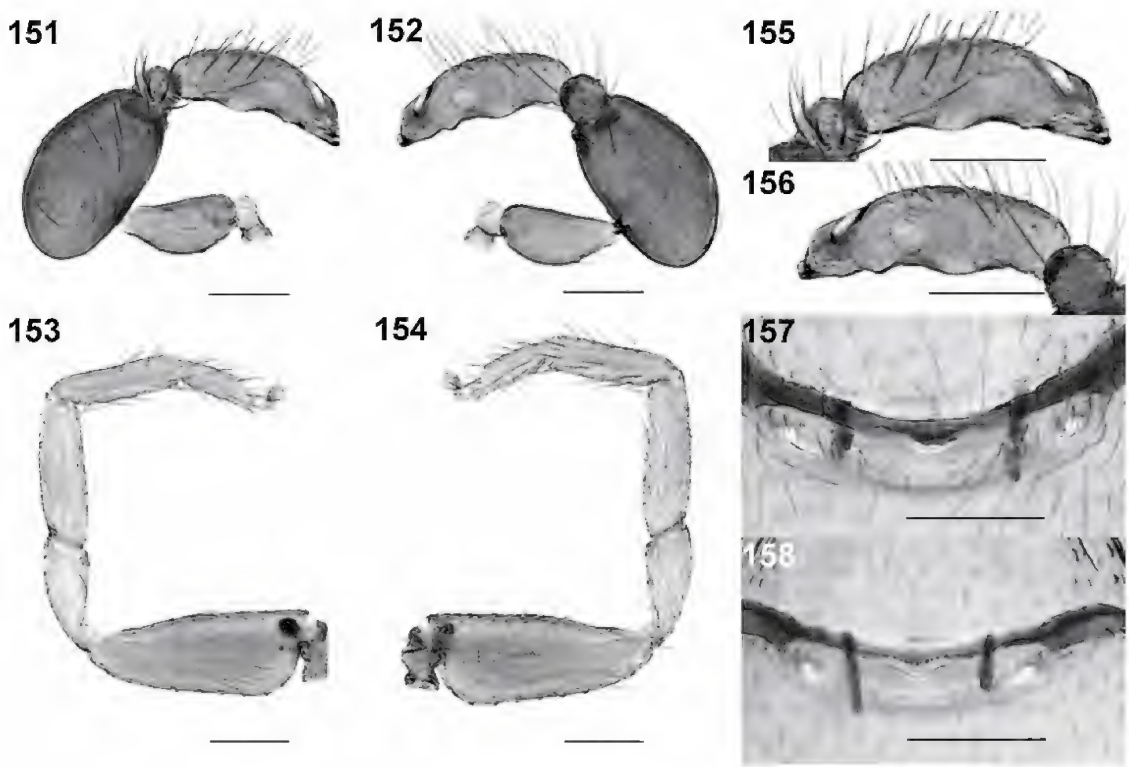


Figs. 138–146. *Opopaea andranomay,* n. sp. **138.** Female, habitus, dorsal view. **139.** Habitus, ventral view. **140.** Abdomen, ventral, view. **141.** Male, habitus, dorsal view. **142.** Habitus, ventral view. **143.** Abdomen, ventral view. **144.** Habitus, lateral view. **145.** Abdomen, lateral view. **146.** Abdomen, anterior view. Scale bars: 0.2 mm.



Figs. 147–150. *Opopaea andranomay,* n. sp., male. **147.** Carapace, anterior view. **148.** Carapace, lateral view. **149.** Carapace, dorsal view. **150.** Carapace, ventral view. Scale bars: 0.2 mm.

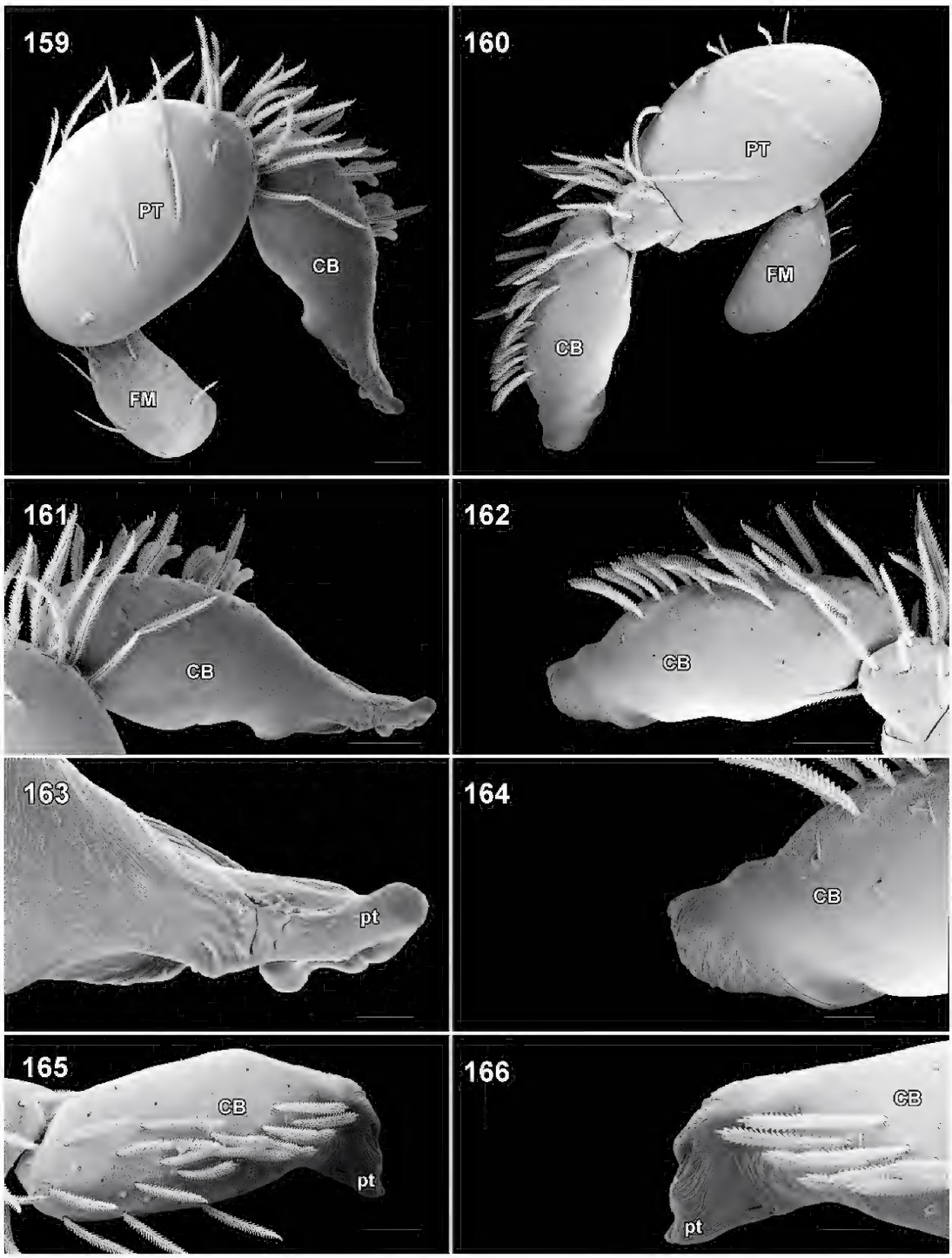
surface of retroclaw; tarsus IV inner claws with four large prolateral teeth and six small distal teeth, outer claws with four large teeth (figs. 75, 76). Tibia with two to three trichobothria, metatarsi with one trichobothria (figs. 71, 73). Trichobothria base rounded, aperture internal texture gratelike, hood smooth (figs. 89, 90, 91, 92). Tarsal organ semiexposed and with longitudinal ridges, with four raised receptors on legs I–II and two on legs III–IV (figs. 81–84). **Genitalia:** Epigastric region with sperm pore visible; furrow without setae. Palp of normal size, right and left palps symmetrical; embolus light, prolateral excavation absent; trochanter of normal size, unmodified; femur not enlarged, of normal size, without posteriorly rounded lateral dilation; patella without prolateral row of ridges, setae unmodified; cymbium narrow in dorsal view, completely fused with bulb, seam visible only in some undescribed *Opopaea* species from Australia



Figs. 151–158. *Opopaea andranomay,* n. sp. **151.** Male, palp, prolateral. **152.** Retrolateral view. **153.** Leg IV, prolateral view. **154.** Leg IV, retrolateral view. **155.** Male, palp close up, prolateral view. **156.** Retrolateral view. **157.** Epigynum, ventral view. **158.** Dorsal view. Scale bars: 153, 154 = 0.2 mm; others = 0.1 mm.

(B. Baehr, personal commun.), not extending beyond distal tip of bulb, plumose setae absent, without stout setae, without distal patch of setae; bulb 1 to 1.5 times as long as cymbium, slender, elongated.

Female: Total length: 1.25–2.43. **Cephalothorax:** Carapace with angular posterolateral corners. Plumose setae near posterior margin of pars thoracica absent. Clypeus: setae present, needlelike. Sternum fused to carapace, radial furrow opposite coxae III absent, surface smooth, without pits, without lumps. Female palp: claws absent; spines absent; tarsus unmodified, patella without prolateral row of ridges. **Abdomen:** Book lung covers anterolateral edge unmodified. Dorsal scutum strongly sclerotized, middle surface punctate, sides punctate, anterior half without projecting denticles. Epigastric scutum without lateral joints. **Legs:** Leg spines absent. Tarsus I superior claws with five teeth on lateral surface of proclaw, nine or more teeth on median surface of proclaw, five teeth on lateral surface of retroclaw, nine or more teeth on median surface of retroclaw; tarsus II superior claws with five teeth on lateral surface of proclaw, nine or more teeth on median surface of proclaw, five teeth on lateral surface of retroclaw, nine or more teeth on median surface of retroclaw; tarsus III superior claws with five teeth on lateral surface of proclaw, five teeth on lateral surface of retroclaw; tarsus IV inner claws with four large prolateral teeth and six small distal teeth, outer claws with four large teeth (figs. 75, 76). Trichobothria: tibia, each with three; metatarsus, each with one. The tracheal system of all 26 Malagasy *Opopaea* consists of two large trunks arising just below the epigastric furrow from each of the two tracheal spiracles. Each tracheal trunk goes anteriorly through the pedicel into the prosoma and posteriorly each trunk branches into numerous tracheoles that spread in the



Figs. 159–166. *Opopaea andranomay,* n. sp. Male palp. **159.** Prolateral view. **160.** Retrolateral view. **161, 163.** Close up, prolateral view. **162, 164.** Close up, retrolateral view. **165.** Anterodorsal view. **166.** Anteroretrolateral. Scale bars: figures 159, 160 = 30 μm; figures 161, 162 = 20 μm; figures 163–166 = 0.10 μm. Abbreviations: **CB,** cymbiobulbus; **FM,** femur; **PT,** patella; **pt,** palp tip.

TABLE 1
List of anatomical abbreviations used in the text and figures

Abf	area before fenestra
Asc	anterior sclerite
AL	abdomen length
ALE	anterior lateral eye
AP	apodeme
AW	abdomen width
BL	bulb
CB	cymbiobulbus (bulb fused to cymbium)
CBL	cymbiobulbus length
CBW	cymbiobulbus width
CH	carapace height
CL	carapace length
cl	clypeus
CPS	carapace plumose setae
CW	carapace width
CY	cymbium
EF	epigastric furrow
EFL	distance between the two lateral apodemes
EGW	eye group width
FI	femur insertion on patella
FM	femur
FML	femur length
FN	fenestra
FT	fenestra top
LAL	distance between epigastric furrow and the shallow groove connecting the tracheal spiracles
LMG	sternal lateral marginal groove
OP	opercula
Pa	parmula
PD	postgynum depression
Pe	pedicel dorsolateral, triangular extensions
PDL	postgynum depression length
PDW	postgynum width
PGI	LAL/EFL
PLE	posterior lateral eye
PME	posterior median eye
Pr	postgynum ridge
PT	patella
pt	palpal tip
PTL	patella length
Re	receptaculum
SC	scutum
SR	scutal ridge
TA	trichobothrial aperture
TB	tibia
TL	total length
TOS	tarsal organ sensilla
TSP	tarsal proclaw

TABLE 2
The top four predictor variables and their average (from 10 replicates) percent contribution for *Opopaea* distribution in Madagascar
(from MAXENT model's internal jackknife test of variable importance)

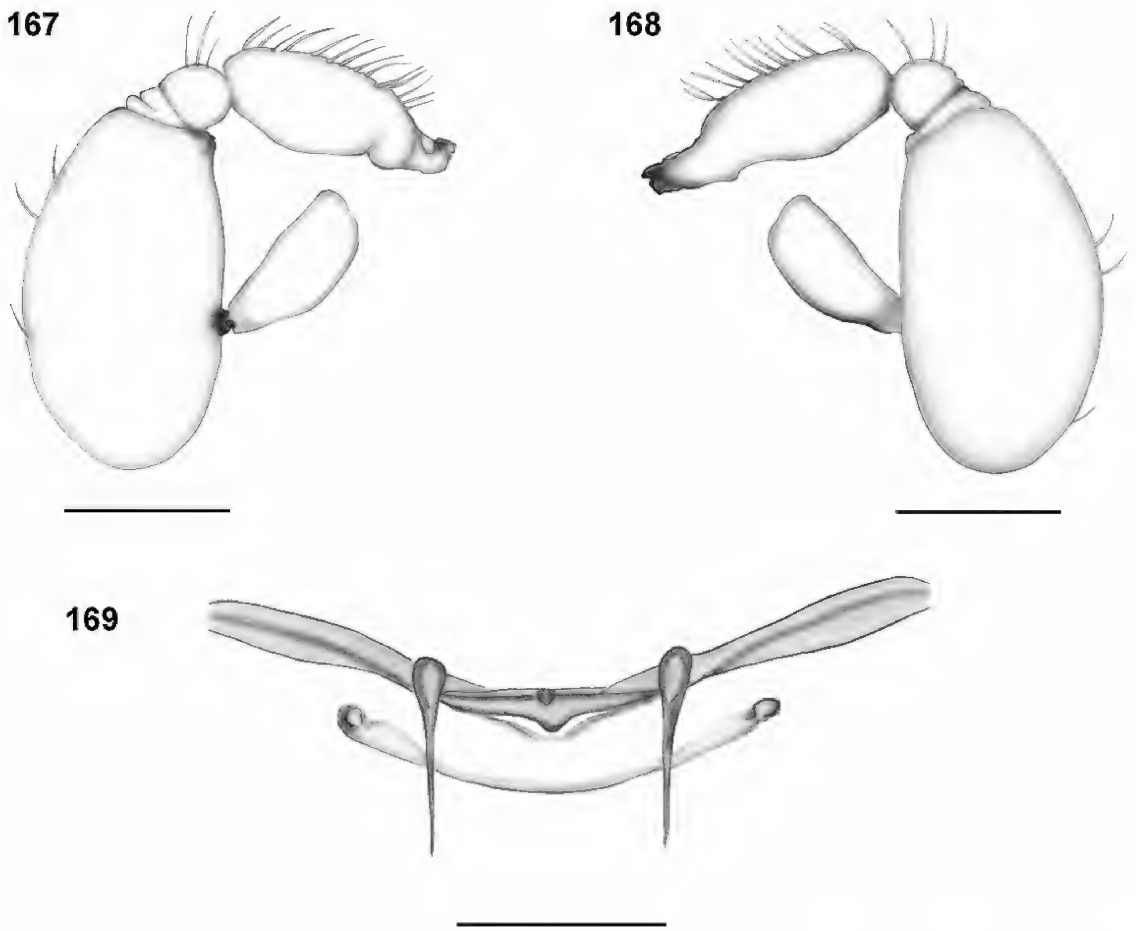
Predictor variables	Contribution (%)
Precipitation of driest month (bio14)	24.2
Precipitation of wettest quarter (bio16)	17.8
Max temperature of the warmest month (bio5)	12.6
Precipitation of the driest month (bio17)	7.2

abdomen (figs. 63–67). Epigynum internally with a T-shaped anterior sclerites (Asc) which ends posteriorly with a small median projection (Na, sensu Burger, 2009). The receptaculum is connected anteriorly to a short and straight tube (Gap) and bear at its anterior surface different numbers (three to four) and pattern of small holes that seems to have glands enclosed inside of them. Receptaculum inverted-arc shaped, of different size, always shorter than lateral apodemes and with a slit posteriorly (figs. 51, 60).

PHYLOGENETICS: The monophyly of *Opopaea* has not been tested yet in a phylogenetic framework. Putative synapomorphies for the genus could be the "postgynum depression" (figs. 47–50) and a series of holes on the anterior part of the receptaculum (fig. 54).

COMPOSITION: There are currently 50 described species of *Opopaea* worldwide. Only the 27 species known from Madagascar are treated here: *Opopaea andranomay,* n. sp., *O. ankarafantsika,* n. sp., *O. ankarana,* n. sp., *O. antsalova,* n. sp., *O. andringitra,* n. sp., *O. antsiranana,* n. sp., *O. bemarivo,* n. sp., *O. bemaraha,* n. sp., *O. berenty,* n. sp., *O. betioky,* n. sp., *O. concolor* (Blackwall, 1859), *O. itampolo,* n. sp., *O. kirindy,* n. sp., *O. manderano,* n. sp., *O. mahafaly,* n. sp., *O. manongarivo,* n. sp., *O. maroantsetra,* n. sp., *O. namoroka,* n. sp., *O. sandranantitra,* n. sp., *O. torotorofotsy,* n. sp., *O. tsimaloto,* n. sp., *O. tsimbazaza,* n. sp., *O. tsimembo,* n. sp., *O. tsinjoriaky,* n. sp., *O. tsingy,* n. sp., *O. vohibazaha,* n. sp., and *O. foulpointe,* n. sp.

NATURAL HISTORY AND DISTRIBUTION: In Madagascar, *Opopaea* species were found all over the island, in different types of habitat, such as montane rainforest, tropical

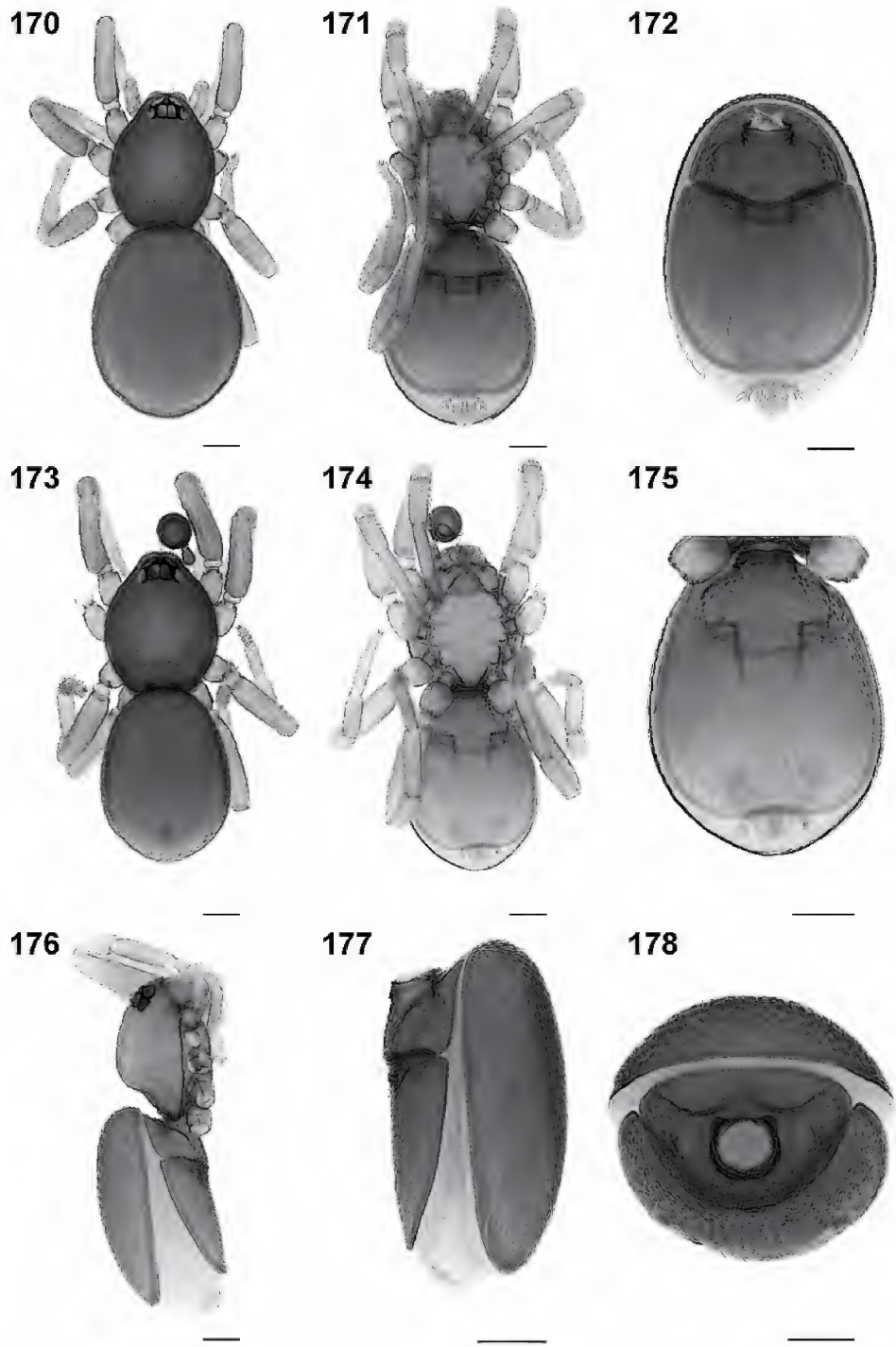


Figs. 167–169. *Opopaea andringitra,* n. sp. **167.** Palp prolateral view. **168.** Retrolateral view. **169.** Epigynum, dorsal view. Scale bars: 0.1 mm.

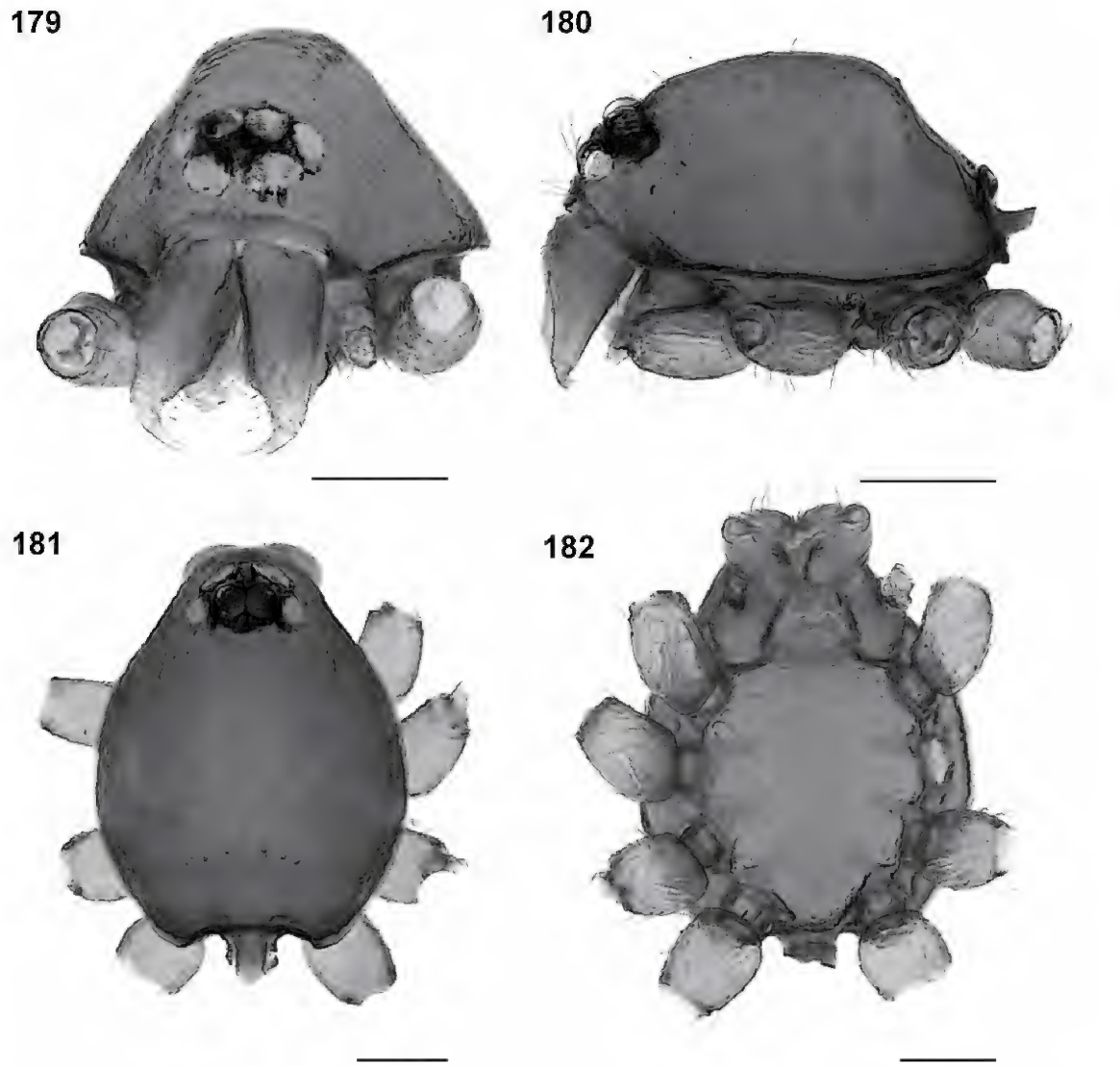
dry forest, spiny/thicket forest, gallery forests, tropical deciduous forest, secondary forests near the beach, and mango and palm plantations from 10–1990 m elevations. *Opopaea* have also been collected in the litter, in dead wood, from trees, and even in the canopy. Given their distribution, one would think of *Opopaea* as a generalist, however, the results from the MAXENT model of their distribution suggests that *Opopaea* species are very sensitive to precipitation. Most of the predicted suitable areas for the genus are found in the eastern, humid part of the island, especially in the northeast and the southeast of Madagascar (map 6) and the MAXENT model's internal jackknife test of variable importance showed that precipitation variables such as "Precipitation of driest month (bio14)" and "Precipitation of wettest quarter (bio16)" were the two most important predictors of *Opopaea*'s habitat distribution in Madagascar (table 2).

KEY TO THE *OPOPAEA* SPECIES OF MADAGASCAR

1. Males 2
– Females 25
2. Cymbiobulbus globular (figs. 668–669, 675–676) . . . . . *O. aroantsetra*
– Cymbiobulbus elongated (all other species, figs. 156, 188, 221) 3
3. Cymbiobulbus without protuberance (figs. 224, 226) . . . . . *O. ankarafantsika*
– Cymbiobulbus with protuberance (all other species, fig. 187–188, 252–253, 805–806) 4

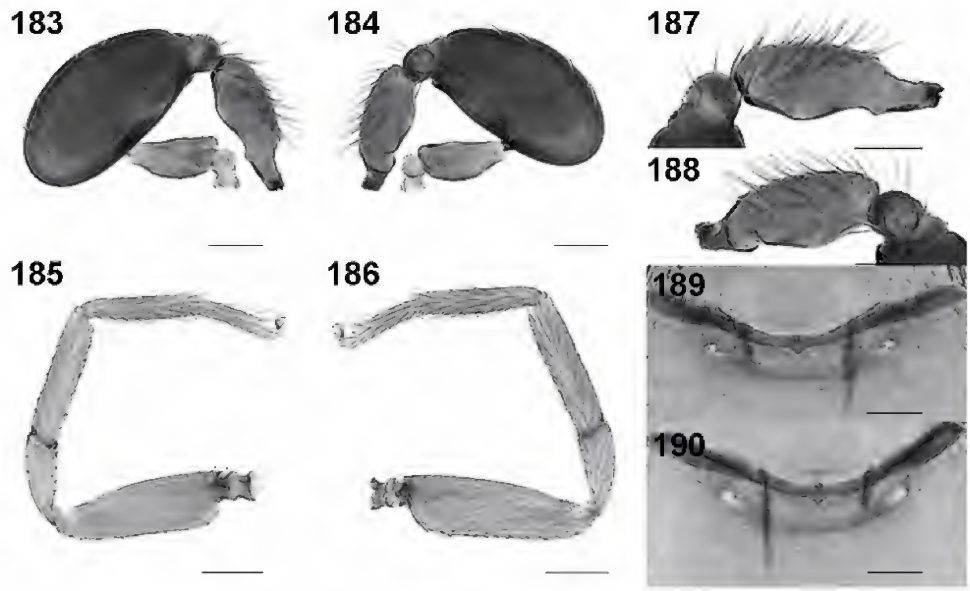


Figs. 170–178. *Opopaea andringitra,* n. sp. **170.** Female, habitus, dorsal view. **171.** Habitus, ventral view. **172.** Abdomen, ventral view. **173.** Male, habitus, dorsal view. **174.** Ventral view. **175.** Abdomen, ventral view. **176.** Habitus, lateral view. **177.** Abdomen, lateral view. **178.** Anterior view. Scale bars: 0.2 mm.



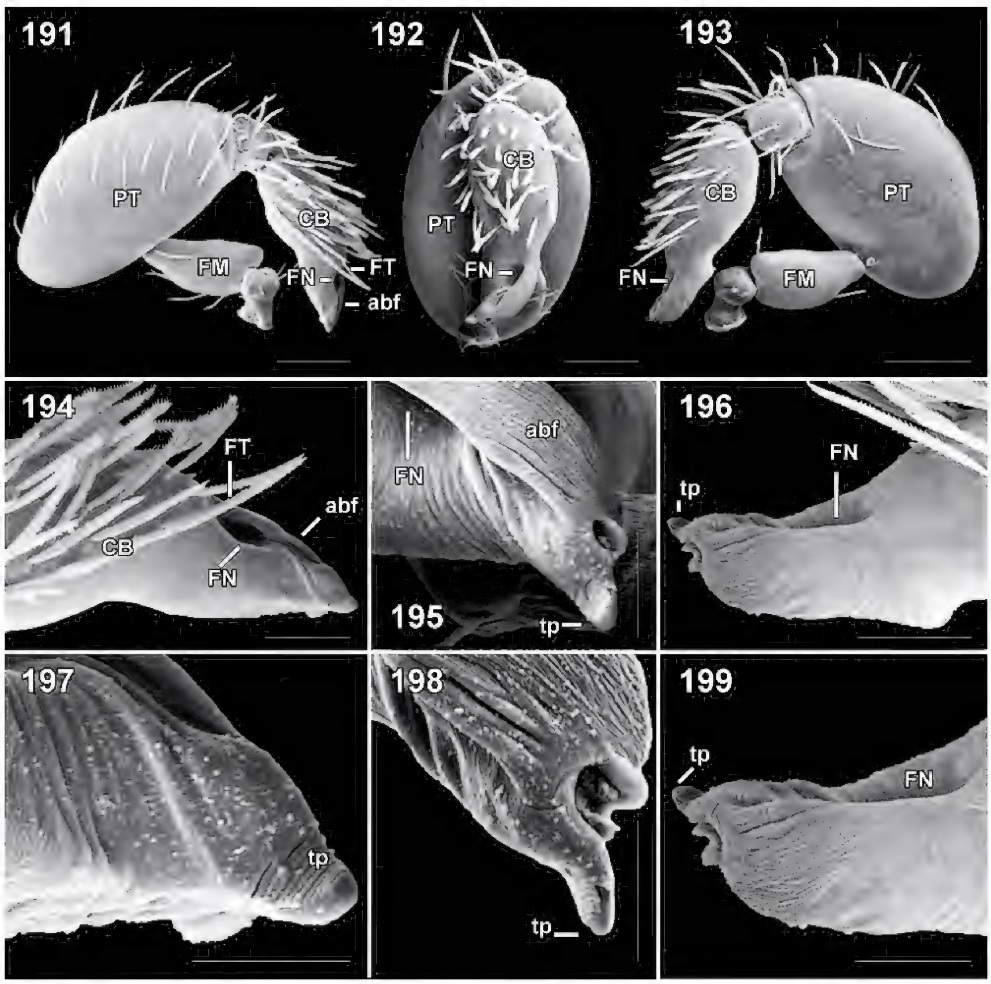
Figs. 179–182. *Opopaea andringitra,* n. sp., female. **179.** Carapace, anterior view. **180.** Lateral view. **181.** Dorsal view. **182.** Ventral view. Scale bars: 0.2 mm.

4. Cymbiobulbus with one distal protuberance (figs. 731, 732) 5
– Cymbiobulbus with different pattern of protuberance (figs. 252, 474) 6
5. Cymbiobulbus tapering anteriorly with dorsal margin curved in an arc shape. Cymbiobulbus tip with sclerotized truncated leaflike extensions (figs. 966, 967). . . *O. vohibazaha*
– Cymbiobulbus not tapering anteriorly but with a truncated edge. Cymbiobulbus tip without extensions (figs. 731, 732, 735, 736) . . . . . *O. sandranantitra*
6. Cymbiobulbus with one posterior protuberance (fig. 766) 7
– Cymbiobulbus otherwise (fig. 474) 10
7. Cymbiobulbus tip with a long, fat, leaf-shaped sclerotized extension directed to the prolateral side . . . . . *O. torotorofotsy*
– Cymbiobulbus tip without a long, fat, leaf-shaped sclerotized extension directed to the prolateral side 8
8. Cymbiobulbus with the area before fenestra (abf) very thick and sclerotized all the way toward the embolar region. Palp tip short, beaklike, and sclerotized (figs. 864, 865, 868, 869) . . . . . *O. tsimembo*
– Cymbiobulbus with the area before fenestra (abf) neither thick nor sclerotized 9



Figs. 183–190. *Opopaea andringitra,* n. sp. **183.** Male, palp, prolateral view. **184.** Retrolateral view. **185.** Leg IV, prolateral view. **186.** Retrolateral view. **187.** Male, palp, close up, prolateral view. **188.** Retrolateral view. **189.** Epigynum, ventral view. **190.** Dorsal view. Scale bars: figures 185, 186 = 0.2 mm; others = 0.1 mm.

9. Tip of the cymbiobulbus on prolateral side with a very thin and compact extension directed downward and bearing above it a round hole . . . . . *O. tsimbazaza*
– Tip of the cymbiobulbus on prolateral side without a thin and compact extension directed downward and not bearing above it a round hole . . . . . *O. antsiranana*
10. Cymbiobulbus with one anterior and one posterior protuberance (fig. 475). 11
– Cymbiobulbus with more than two posterior protuberances (fig. 156) 24
11. Sternum posterior part with protrusions or lumps (figs. 245, 247). 12
– Sternum posterior part without protrusion or lumps (fig. 142). 16
12. Sternum posterior part constricted then enlarged posteriorly, with two lateral L-shaped longitudinal lumps. Cymbiobulbus resembling a parrot beak. Palpal femur inserted at the end of patella (figs. 466, 469, 474, 475) . . . . . *O. foulpointe*
– Sternum posterior part not constricted nor enlarged posteriorly, without lateral L-shaped longitudinal lumps. Cymbiobulbus not resembling a parrot beak. Palpal femur not inserted at the end of patella 13
13. Posterior part of sternum with one longitudinal median protrusion. Carapace with two lateral denticles forming two sharp, spikelike lateral denticules. Sternum posterior part more or less rectangular (figs. 245, 247) 14
– Sternum posterior part with a U-shaped median protrusion (fig. 525). 15
14. Tip of the cymbiobulbus large, round, pointing downward (fig. 249). . . . . *O. ankarana*
– Tip of cymbiobulbus also rounded, but bearing a more or less long sclerotized embolic extension that folds laterally on the retrolateral side. . . . . *O. manongarivo*
15. Dark-brown coloration. Carapace pars cephalica strongly elevated medially with numerous rows of thick and stiff hairs. Sternum surface punctuate. Tip of cymbiobulbus tubular, sclerotized, and curved downward (figs. 513, 523–525, 531). . . . . *O. kirindy*
– Orange coloration. Carapace pars cephalica not elevated medially without rows of thick and stiff hairs. Sternum surface smooth. Tip of cymbiobulbus not tubular, but thick and sclerotized (figs. 276–278, 283–284) . . . . . *O. antsalova*
16. Distal part of cymbiobulbus truncated and rectangular (figs. 187–188). . . *O. andringitra*
– Distal part of cymbiobulbus neither truncated nor rectangular. 17
17. Opercula small (figs. 498, 694) 18
– Opercula medium to large (figs. 374, 430) . . . 22
18. Paired scutal ridges not joined or consisting of two separate lobes (figs. 694, 796). . . . 19



Figs. 191–199. *Opopaea andringitra,* n. sp., male palp. **191.** Prolateral view. **192.** Anterior view. **193.** Retrolateral view. **194, 197.** Close up, prolateral view. **195, 198.** Embolar region, apical view. **196, 199.** Retrolateral view. Scale bars: figures 191–193 = 40 μm; figures 194, 196, 199 = 20 μm; figures 195, 197, 198 = 10 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

– Paired scutal ridges medially joined or consisting of one large lobe (figs. 498, 923). 20

19. Palpal patella obviously larger and longer than cymbiobulbus and connected medially to femur (figs. 699, 700). . . . . *O. namoroka*

– Palpal patella not obviously larger nor longer than cymbiobulbus and connected subbasally to femur (figs. 801, 802). . . . . *O. tsimaloto*

20. Palpal fenestra top (FT) raised dorsally (figs. 932, 939), palp tip (pt) with two short, liplike extensions (figs. 932, 933, 941) . . . . . *O. tsinjoriaky*

– Palpal fenestra top (FT) not raised dorsally, palp tip (pt) without a short, liplike extensions (figs. 507, 508) 21

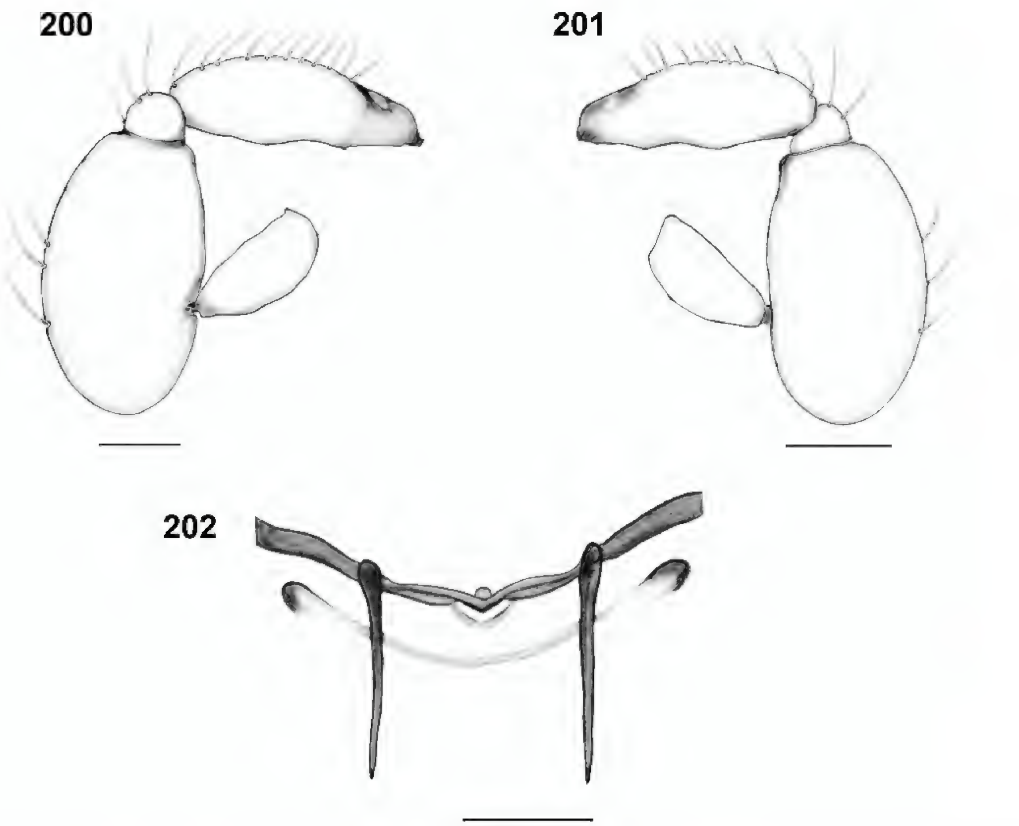
21. Cymbiobulbus tip (pt) terminated with a sclerotized, long, and straight extension (figs. 600, 601, 609, 611) . . . *O. manderano*

– Cymbiobulbus tip (pt) not terminated with a sclerotized, long, and straight extension (figs. 507, 508) . . . . . *O. itampolo*

22. Color yellowish, carapace flat and elongated, hexagonal (figs. 375–378); abdomen elongated, rectangular (fig. 370) . . . . . *O. bemarivo*

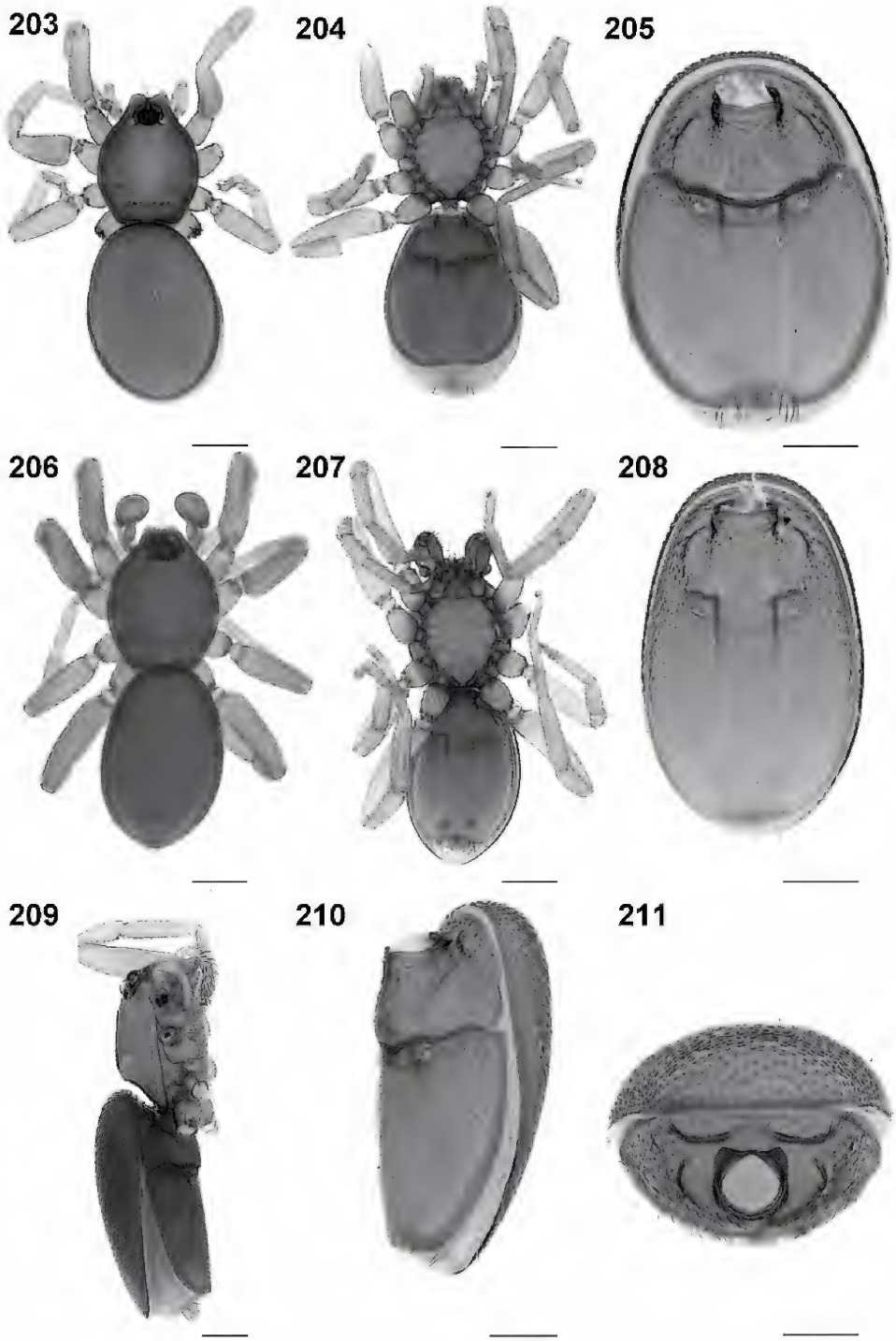
– Color orange to dark orange, carapace neither flat nor hexagonal; abdomen ovoid 23

23. Opercula with sclerotized ridges (fig. 146), carapace strongly elevated with chelicera with bosses and detached from clypeus edge (figs. 147–149). . . . . *O. andranomay*

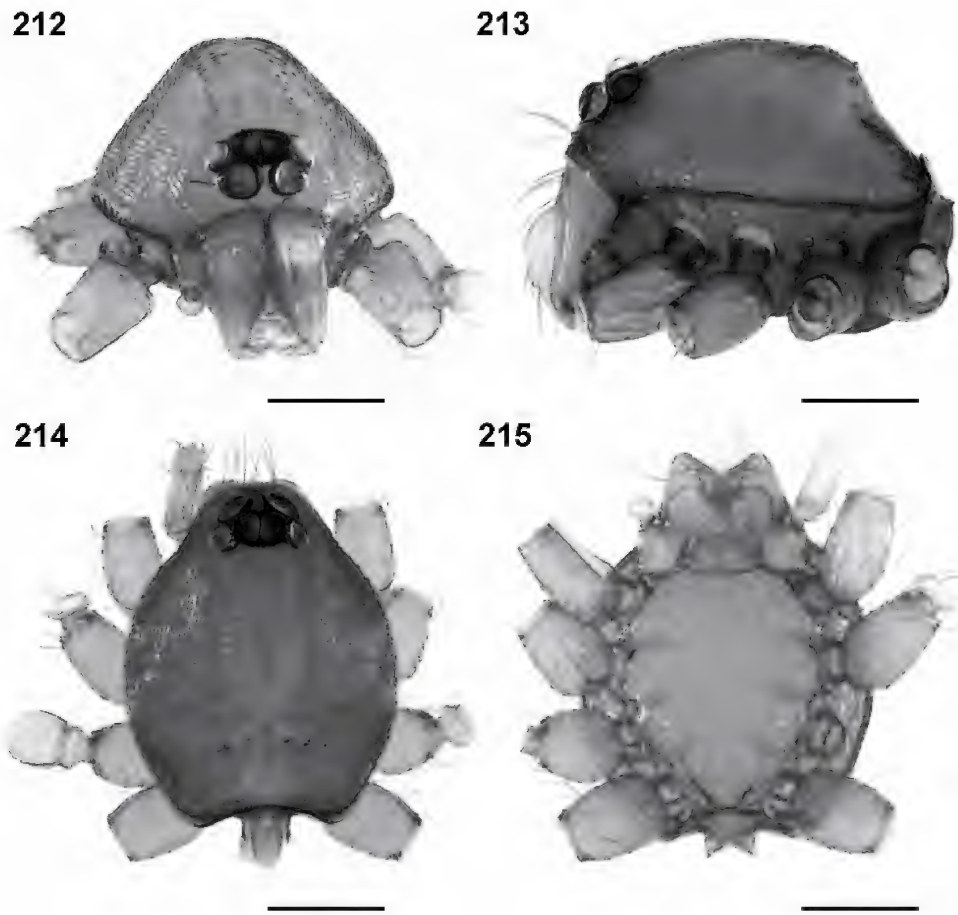


Figs. 200–202. *Opopaea ankarafantsika,* n. sp. **200.** Male palp prolateral view. **201.** Retrolateral view. **202.** Epigynum, dorsal view. Scale bars: 0.1 mm.

– Opercula without sclerotized ridges, carapace slightly elevated with chelicera without bosses and not detached from clypeus edge (figs. 557–560, 892–895) 24
24. Eyes large (ratio of diameter of ALE to female body size more than 0.040 mm, figs. 557–560) . . . . . *O. mahafaly*
– Eyes small (ratioof diameter of ALE to female body size less than 0.040 mm, figs. 557–560) . . . . . *O. tsingy*
25. Postgynum depression U-shaped (figs. 385, 441, 602) 26
– Postgynum depression not U-shaped (figs. 158, 190) 28
26. Carapace flattened, abdomen elongated, rectangular (figs. 368, 375, 376) . . . *O. bemarivo*
– Carapace not flattened, abdomen ovoid (figs. 424, 432) 27
27. Postgynum depression ridge laterally sclerotized (fig. 603). . . . . *O. manderano*
– Postgynum depression ridge not laterally sclerotized (figs. 441, 442) . . . . . *O. betioky*
28. Postgynum depression V-shaped (figs. 285, 509, 838). 29
– Postgynum not depression V-shaped (figs. 476, 706) 32
29. Paired scutal ridges medially joined . . . . . *O. Itampolo*
– Paired scutal ridges not medially joined (figs. 234, 827) 30
30. Postgynum depression very narrow, V-shaped (figs. 838, 839) . . . . . *O. tsimbazaza*
– Postgynum depression a very wide V-shape (figs. 285, 286) 31
31. Postgynum depression ridge thick, parmula above epyginum scutal ridge . . . *O. antsalova*
– Postgynum depression ridge not thick, parmula detached from epyginum scutal ridge. . . . . *O. concolor*
32. Postgynum depression slitlike (figs. 318, 319, 476, 477) 33
– Postgynum depression otherwise (fig. 772) 38
33. Abdomen apodemes extend beyond ½ of abdomen length . . . . . *O. foulpointe*
– Abdomen apodemes short (not reaching ½ of abdomen length). 34
34. Abdomen laterally flattened (figs. 306, 555). 35

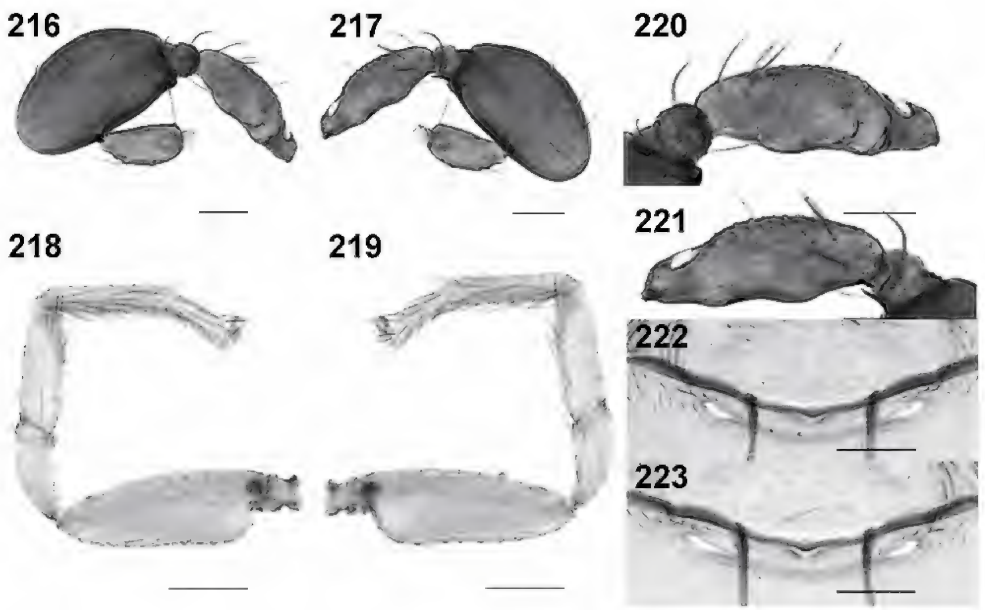


Figs. 203–211. *Opopaea ankarafantsika,* n. sp. **203.** Female, habitus, dorsal view. **204.** Habitus, ventral view. **205.** Abdomen, ventral view. **206.** Male, habitus, dorsal view. **207.** Ventral view. **208.** Abdomen, ventral view. **209.** Habitus, lateral view. **210.** Abdomen, lateral view. **211.** Anterior view. Scale bars: 0.2 mm.



Figs. 212–215. *Opopaea ankarafantsika,* n. sp., female. **212.** Carapace, anterior view. **213.** Lateral view. **214.** Dorsal view. **215.** Ventral view. Scale bars: 0.2 mm.

– Abdomen not laterally flattened (fig. 657) 36
35. Abdomen round, opercula diameter less than ½ of pedicel diameter (figs. 301, 307) . . . . . *O. antsiranana*
– Abdomen not round, opercula diameter ½ or more than ½ of pedicel diameter, epigynum scutal ridge dropping down medially (figs. 550, 556, 567) . . . . . *O. mahafaly*
36. Parmula above epigynal scutal ridge, scutal ridge divided (figs. 737, 738) . . . . . *O. sandranantitra*
– Parmula and scutal ridge otherwise 37
37. Parmula within scutal ridge (fig. 968) . . . . . *O. vohobazaha*
– Parmula below scutal ridge (fig. 671) . . . . . *O. maroantsetra*
38. Postgynum depression inverted-arc shaped (figs. 773, 870, 934) 39
39. Postgynum depression short and narrow (figs. 157, 189, 222, 255, 352) 40
– Postgynum depression otherwise 43
40. Color dark orange, scutal ridge medially dropping into a reverse triangle (figs. 170, 189) . . . . . *O. andringitra*
– Color orange, scutal ridge not medially dropping into a reverse triangle 41
41. Paired extensions on pedicel area small and widely separated from each other, scutal ridge straight (fig. 341) . . . . . *O. bemaraha*
– Paired extensions on pedicel area large and close to each other, scutal ridges curved 42
42. Opercula outer edge thick and sclerotized (fig. 211) . . . . . *O. ankarafantsika*
– Opercula outer edge not thick and not sclerotized (fig. 211) . . . . . *O. ankarana*
43. Postgynum ridge thin and not sclerotized (figs. 409, 532, 636, 902) 44



Figs. 216–223. *Opopaea ankarafantsika,* n. sp. **216.** Male, palp, prolateral view. **217.** Retrolateral view. **218.** Leg IV, prolateral view. **219.** Leg IV, retrolateral view. **220.** Male, palp, close up, prolateral view. **221.** retrolateral view. **222.** Epigynum, ventral view. **223.** Dorsal view. Scale bars: figures 218, 219 = 0.2 mm; others = 0.1 mm.

– Postgynum ridge thick and sclerotized (figs. 870, 934) 47

44. Abdomen round and flattened (figs. 391, 396, 890) 45
– Abdomen round but not flattened (figs. 515, 618) 46

45. Parmula on top of a thickened arclike structure (fig. 902). . . . . O. tsingy
– Parmula almost invisible and not on top of a thickened arclike structure (fig. 409) . . . . . *O. berenty*

46. Body small (1.0–1.5 mm), orange. Pedicel paired extensions well developed and close to each other, groove connecting posterior spiracles sclerotized (figs. 616, 624, 635) . . . . . *O. manomgarivo*
– Body large (1.85–2 mm), dark orange. Pedicel paired extensions small and widely separated from each other, groove connecting posterior spiracles not sclerotized (figs. 513, 521, 532) . . . . . *O. kirindy*

47. Postgynum depression as wide as the distance between the lateral apodemes and almost as long as the distance between epigastric furrow and the shallow groove connecting the tracheal spiracles (figs. 772, 773) . . . . . *O. torotorofotsy*
– Postgynum depression width less than the distance between the lateral apodemes and length less than the distance between epigastric furrow and the shallow groove connecting the tracheal spiracles (figs. 808, 870, 934) 48

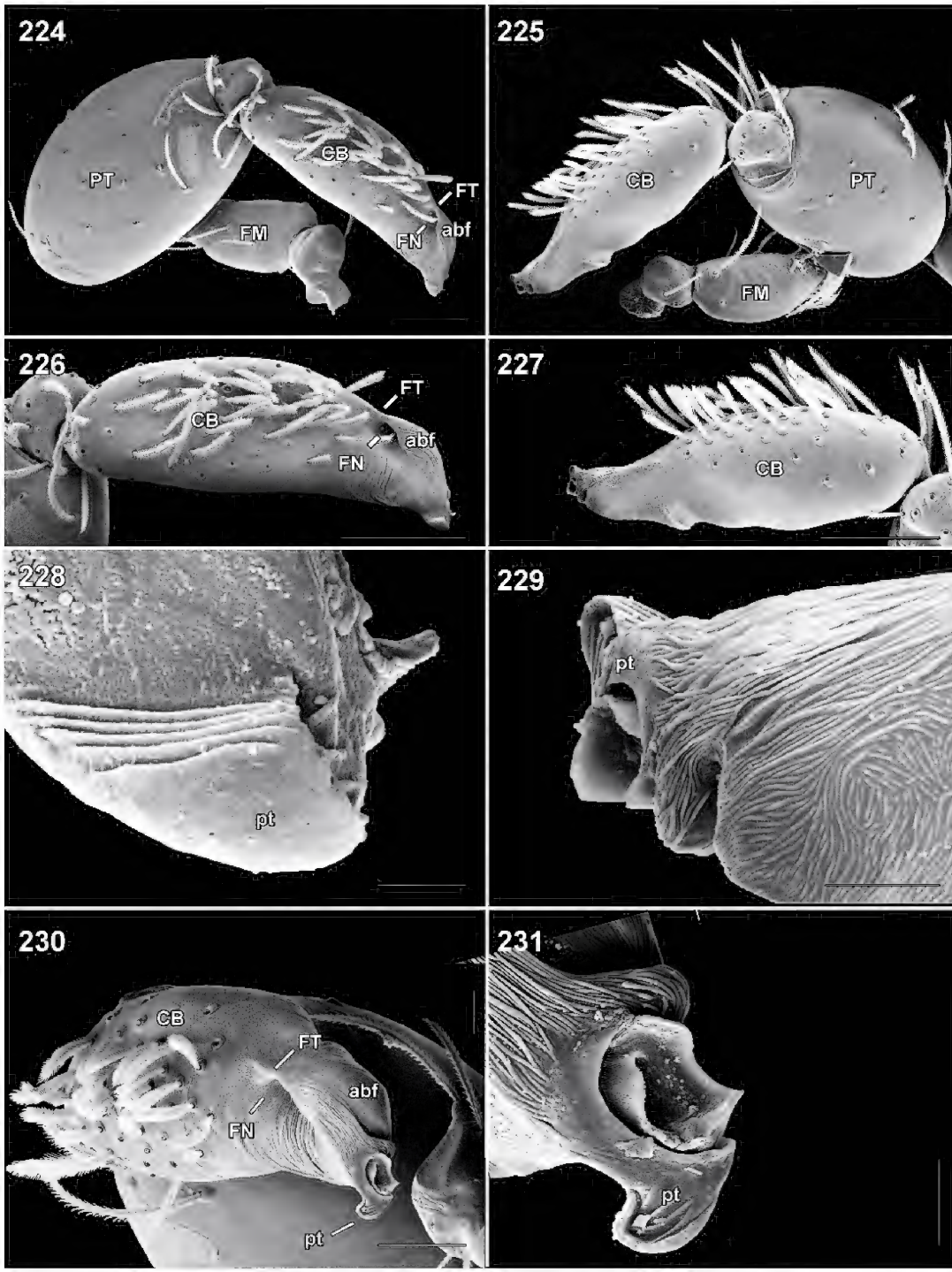
48. Paired scutal ridges medially joined (figs. 859, 923) 49
– Paired scutal ridges not medially joined (figs. 694, 796) 50

49. Abdomen flat, postgynum depression ridge extremely thick (figs. 921, 934) . . . . . *O. tsinjoriaky*
– Abdomen not flattened, postgynum depression ridge not extremely thick (figs. 853, 870) . . . . . *O. tsimembo*

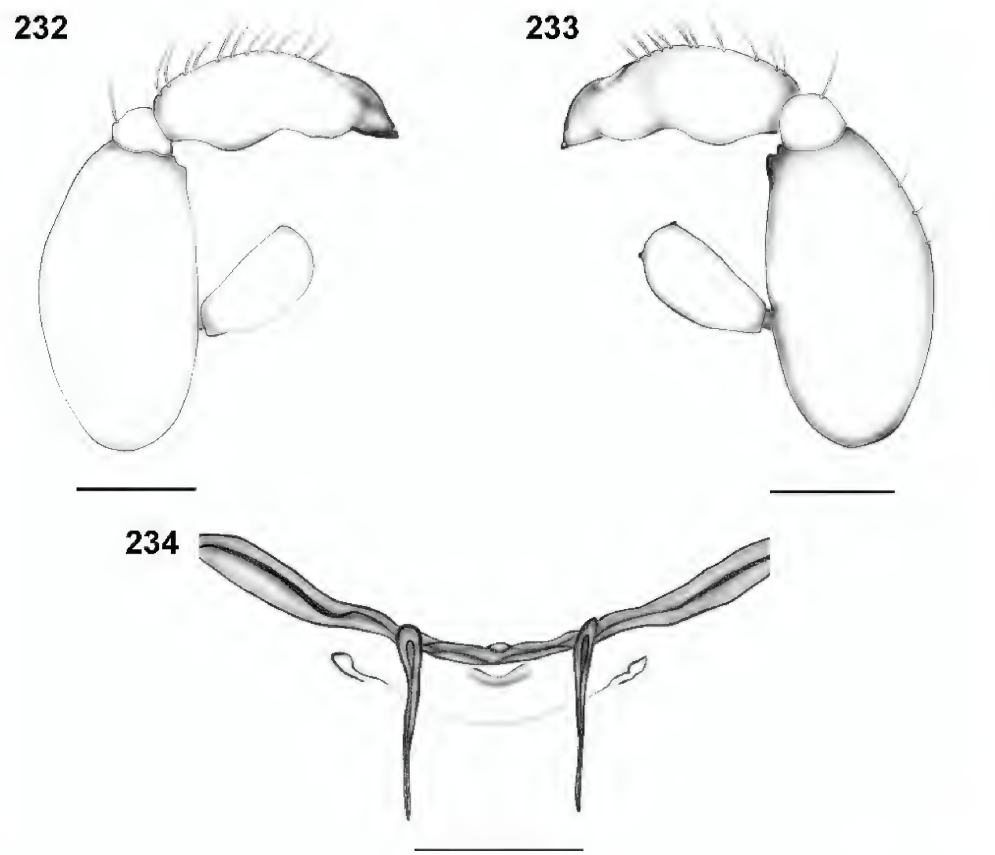
50. Paired triangular extensions on pedicel area barely visible or less than two times higher than pedicel border and widely separated from each other, postgynum depression ridge medially thickened (figs. 796, 808) . . . . . *O. tsimaloto*
– Paired triangular extensions on pedicel area two times higher than pedicel border and close to each other, postgynum depression-ridge not medially thickened (figs. 694, 706) . . . . . *O. namoroka.*

Opopaea concolor (Blackwall, 1859)
Figures 101–134; map 4

Oonops concolor Blackwall, 1859: 265 (male and female syntypes from Madeira, should be in the



Figs. 224–231. *Opopaea ankarafantsika,* n. sp., male palp. **224.** Prolateral view. **225.** Retrolateral view. **226.** Close up, prolateral view. **227.** Retrolateral view. **228.** Embolar region, prolateral view. **229.** Retrolateral view. **230.** Anterior view. **231.** Tip, anterior view. Scale bars: figures 224–225 = 40 μm; figures 226, 227, 230 = 30 μm; figures 228, 229 = 4 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.



Figs. 232–234. *Opopaea ankarana,* n. sp. **232.** Palp prolateral view. **233.** Retrolateral view. **234.** Epigynum, dorsal view. Scale bars: 0.1 mm.

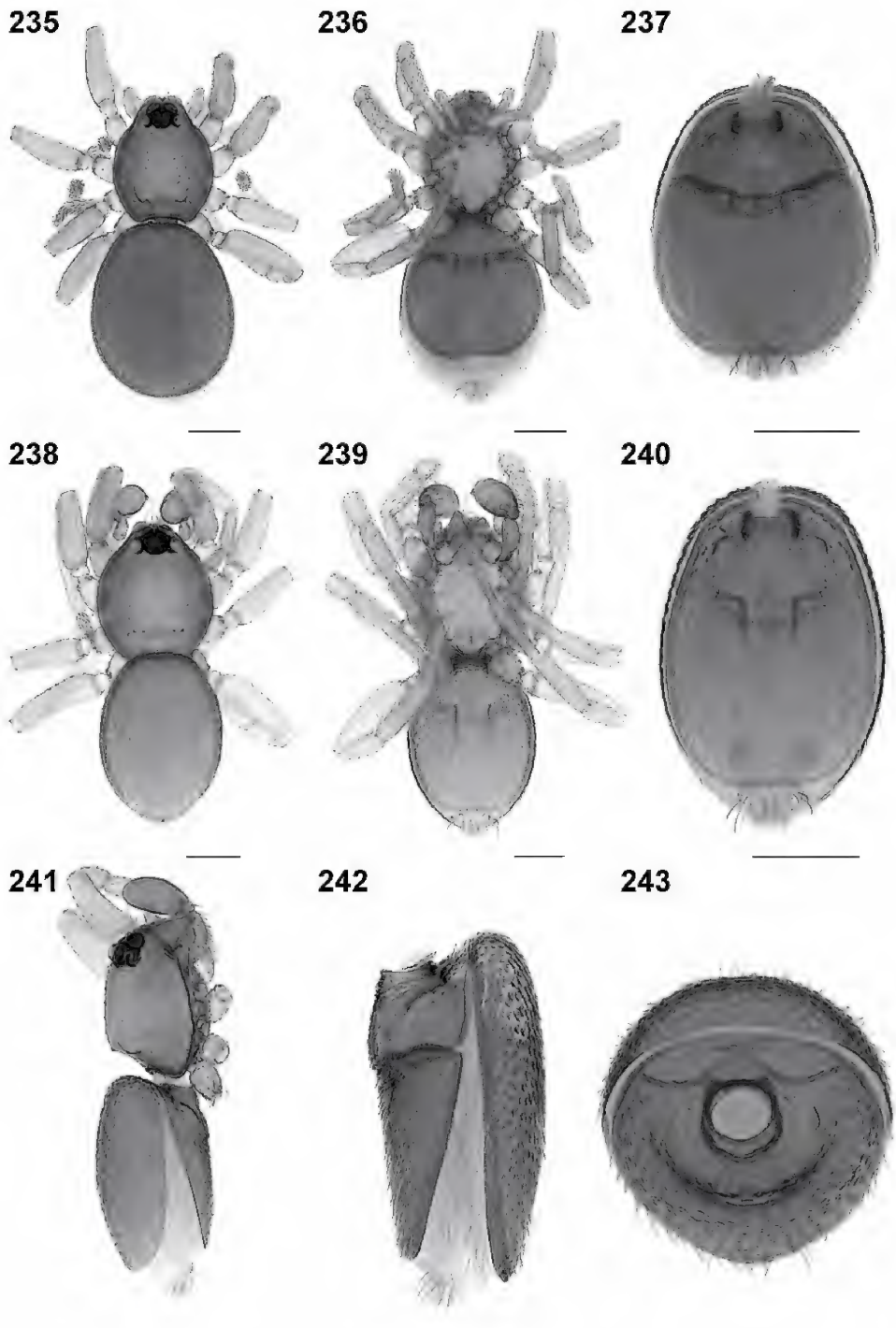
Department of Entomology, Oxford University, not examined).

Opopaea concolor: Kulczynski, 1899: 339, pl. 6, fig. 25; Wunderlich, 1987: 63, figs. 24–26; Saaristo, 2001: 333, figs. 22, 23a, 23b, 24a, 24b, 25a, 25b, 26a, 26b, 27; Saaristo, 2007: 136, figs. 90–92; Saaristo and Marusik, 2008: 20, figs. 13–21, 119–121, 123–132, 193, 199, 218, 228; Platnick and Dupérré, 2009: 43, figs. 73–104.

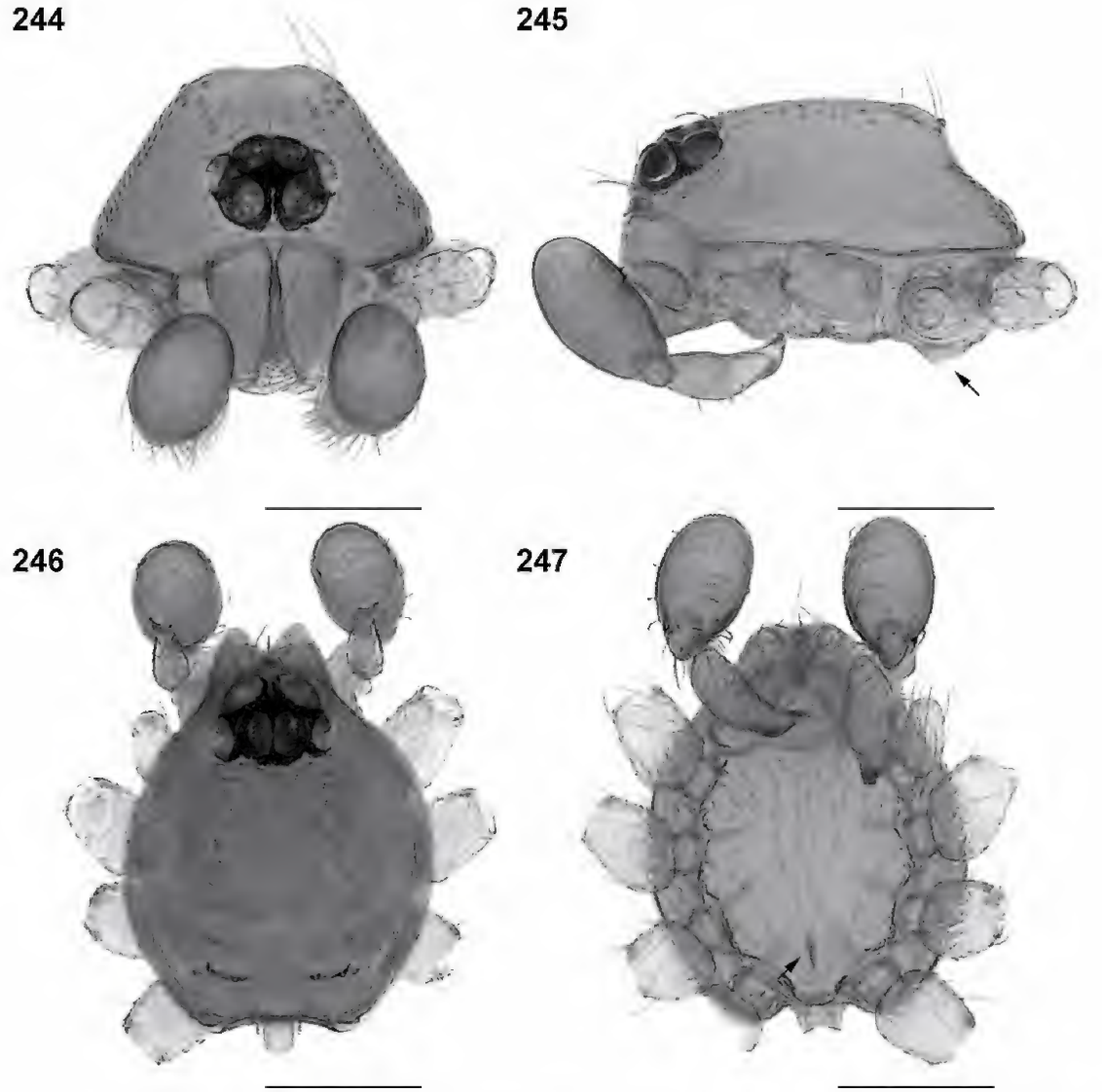
DIAGNOSIS: Females of *O. concolor* can be easily recognized by a small sclerotized, teardrop-shaped parmula, completely detached from a thin, sclerotized scutal ridge and a postgynum depression constricted in its median part where it surrounds the parmula (figs. 103, 123).

NOTE: No males of this species have been found from the Madagascar collection studied. Therefore, only the female is described here. However, illustrations of a male from Mexico (PBI_OON 34433) from our loans are provided.

DESCRIPTION: Female from Besalampy (PBI_OON 36291, figs. 103, 104–106, 123). Medium-sized species. Total length 1.44. Color: yellowish orange. Carapace: pars cephalica not elevated posteriorly, with one row of two sets of three denticles (figs. 114, 115). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes small. ALE largest. ALE oval, PME and PLE circular; PME darkened compared to other eyes; posterior eye row straight viewed from above, procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae; surface smooth, without pits, shape of posterior part between coxae IV hexagonal, not constricted (fig. 116). Lateral margins of



Figs. 235–243. *Opopaea ankarana,* n. sp. **235.** Female, habitus, dorsal view. **236.** Ventral view. **237.** Abdomen, ventral view. **238.** Male, habitus, dorsal view. **239.** Ventral view. **240.** Abdomen, ventral view. **241.** Habitus, lateral view. **242.** Abdomen, lateral view. **243.** Anterior view. Scale bars: 0.2 mm.

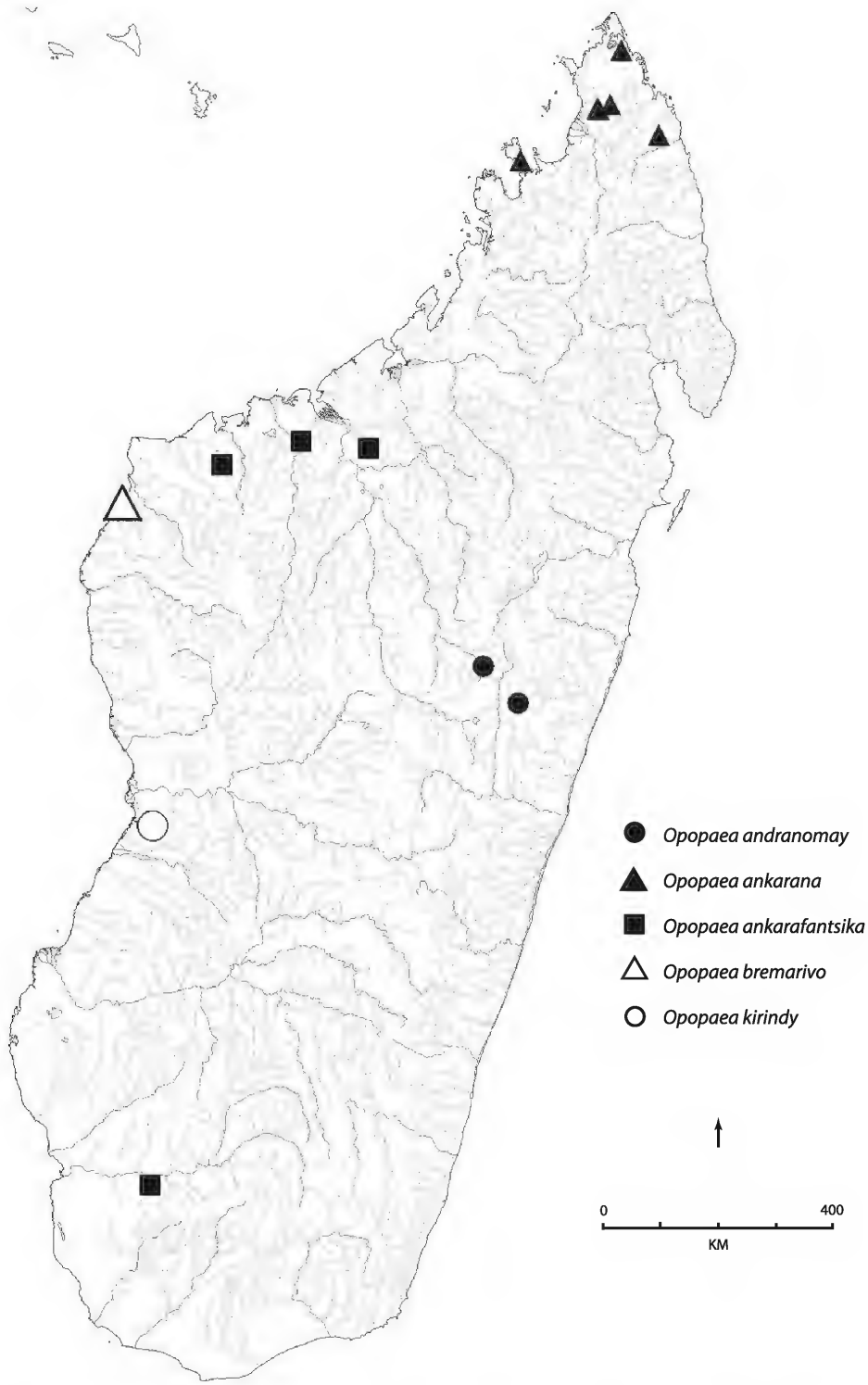


Figs. 244–247. *Opopaea ankarana,* n. sp., male. **244.** Carapace, anterior view. **245.** Lateral view. **246.** Dorsal view. **247.** Ventral view. Scale bars: 0.2 mm.

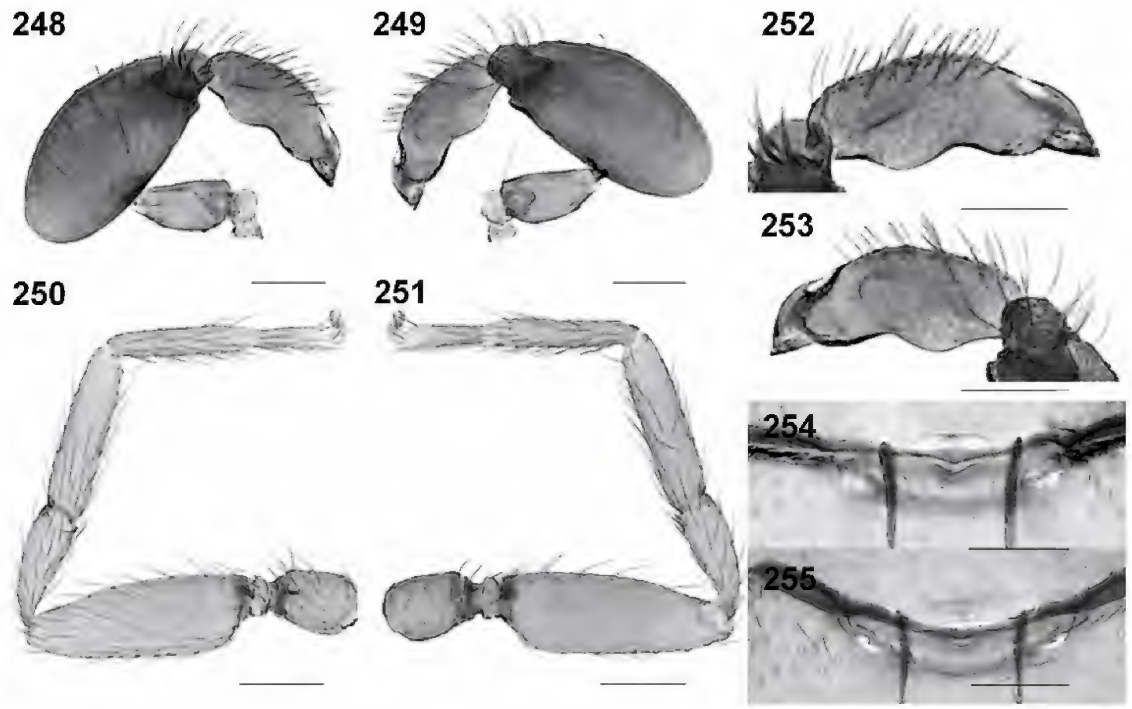
area between coxae III unmodified, without lumps; setae more or less abundant and evenly distributed, originating from surface, without hair tufts (figs. 113–116). Epigynum with a postgynum depression half the length of distance between epigastric furrow and shallow groove connecting tracheal spiracles and as wide as distance between the two lateral apodemes. Postgynum depression ridge thin and very weakly sclerotized (figs. 103, 123).

MEASUREMENTS: Female from Besalampy (PBI_OON 36291). TL: 1.44; CL: 0.59; CW: 0.45; CH: 0.19; AL: 0.91; AW: 0.60; ALE: 0.07; PME: 0.05; PLE: 0.05; EGW: 0.15; ALE-ALE: 0.02; ALE-PLE: 0; PME-PME: 0; PLE-PME: 0; EFL: 0.12; LAL: 0.08; PGI (LAL/EFL): 0.66; PDL/LAL: 0.62; PDW/EFL: 1.

VARIATION: Female. TL: 1.44–1.46; CL: 0.59–0.59; CW: 0.45–0.45; AL: 0.88–0.91; AW: 0.60–0.62.



Map 1. Specimen records of *Opopaea* species in Madagascar: *O. andranomay, ankarana, ankarafantsika, bemarivo,* and *kirindy.*



Figs. 248–255. *Opopaea ankarana,* n. sp. **248.** Male, palp, prolateral view. **249.** Retrolateral view. **250.** Leg IV, prolateral view. **251.** Retrolateral view. **252.** Male, palp, close up, prolateral view. **253.** Retrolateral view. **254.** Epigynum, ventral view. **255.** Dorsal view. Scale bars: figures 250, 251 = 0.2 mm; others = 0.1 mm.

NATURAL HISTORY: *O. concolor* was mostly found in palm forest and in rainforest at 10 m and 1990 m elevations.

DISTRIBUTION: Mostly found in the south-central and west coast regions of Madagascar in the provinces of Fianarantsoa and Mahajanga (map 4).

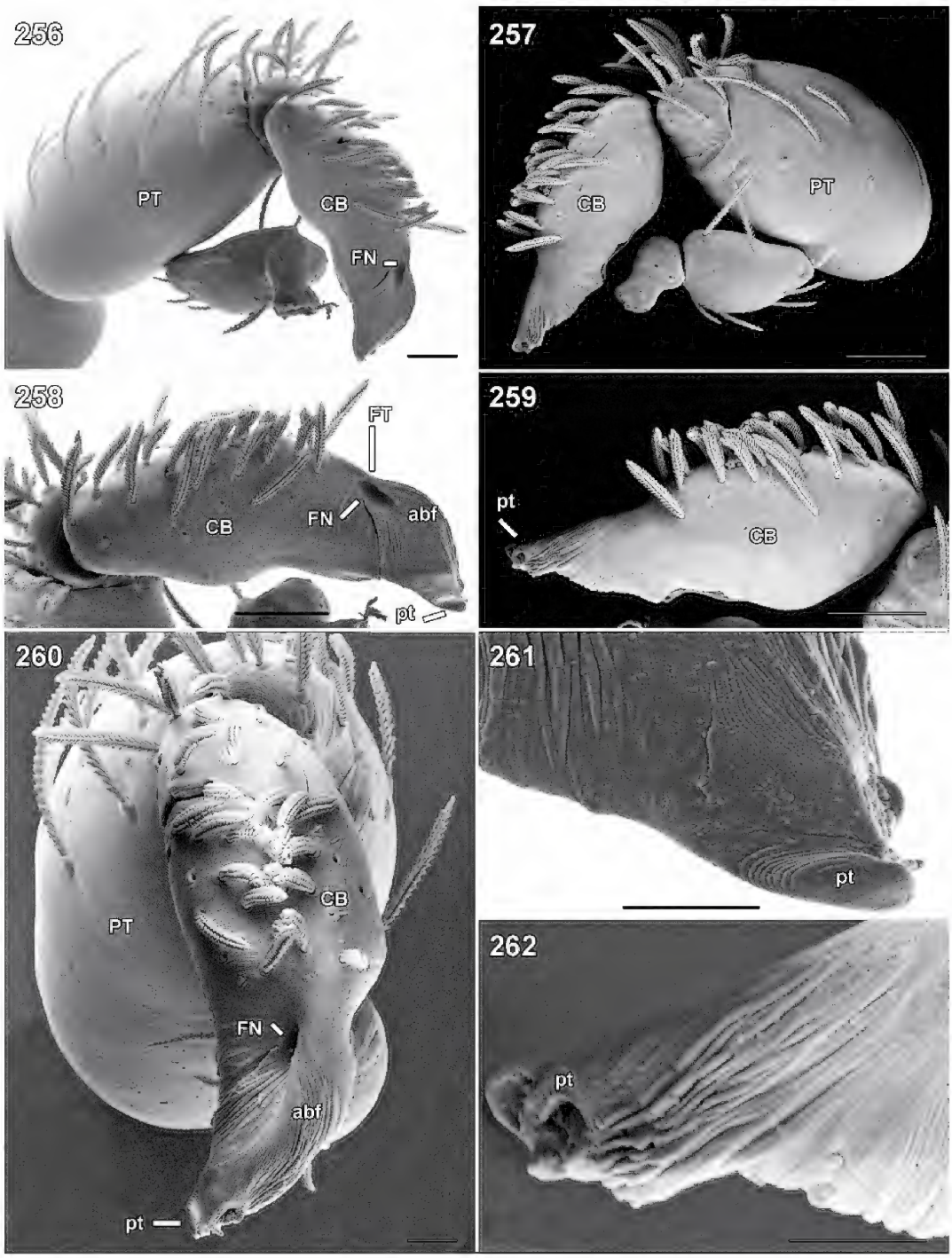
MATERIAL EXAMINED: MADAGASCAR: **Mahajanga:** Besalampy, Marofototra palm forest, 17 km W Besalampy, 16°43.30′S, 44°25.42′E; 10 m, palm trees on sand, malaise, 06–13 October 2008, M. Irvin, R. Harin'Hala (CASC PBI_OON 36291), 1♀. **Fianarantsoa:** Résèrve Andringitra, 8.5 km SE Antanitotsy, 22°10′S, 46°58′E, 1990 m, sifting litter, rainforest. 06 March 1997. B.L. Fisher (CASC PBI_OON 35056), 1♀. SEYCHELLES: **St. Helena East:** E. Prosperous Bay plain, 1000–1100 ft, Rec. Decelle J. and Leleup N, 5–6 May 1967 (MRAC PBI_OON 34454), 1♂; (MRAC PBI_OON 34466), 1♀ 29 April 1967 (MRAC PBI_OON 34453), 1♀ St. Helena, E. Great Stone Top, Rec. Decelle J. and Leleup N, 18 April 1967 (MRAC PBI_OON 34468), 1♀. MEXICO: Hidalgo, Taxquillo (Tzindejeh), 29 July 1966, Jand W. Ivie (AMNH PBI_OON 34433), 3♂.

Opopaea andranomay, new species
Figures 135–166; map 1

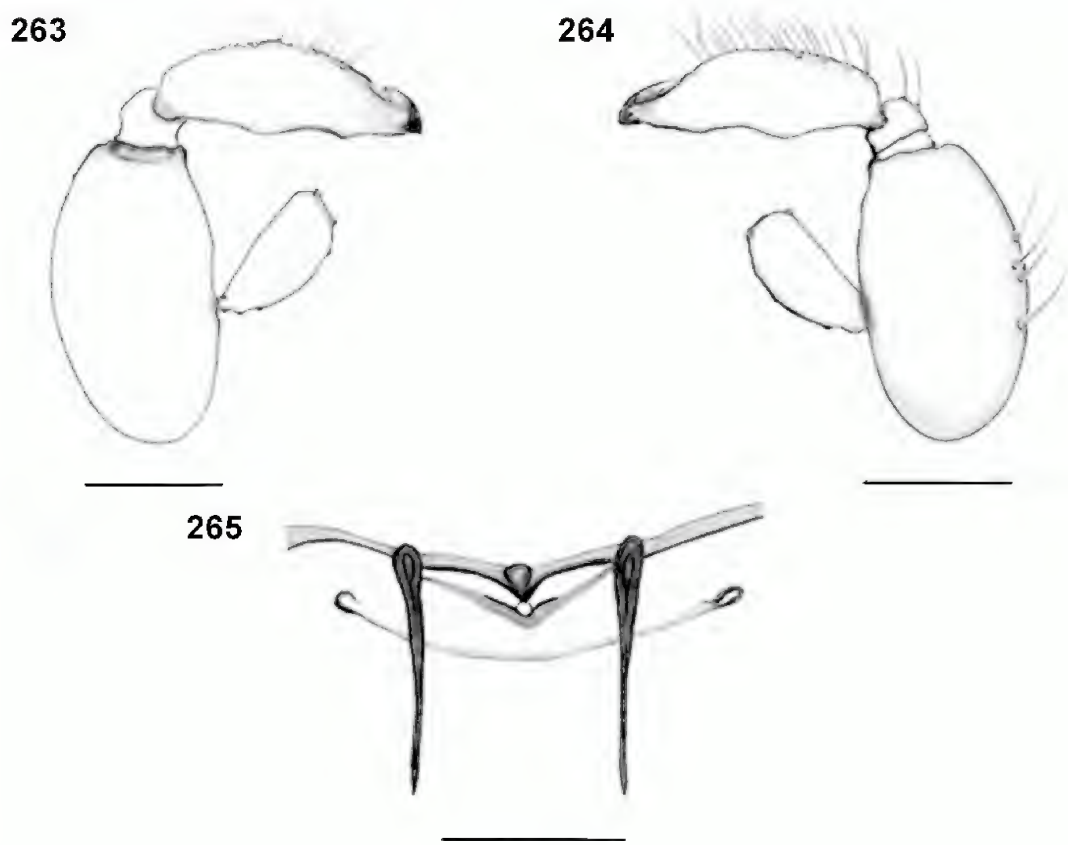
TYPES: Male holotype from Antananarivo: 3 km 41° NE Andranomay, 11.5 km 147° SSE Anjozorobe, 18°28′24″S, 47°57′36″E, 1300 m, pitfall traps, montane rainforest, 05–13 December 2000, Fisher-Griswold Arthropod Team (CASC PBI_OON 34422). Female allotype from Toamasina: Ambatovy, 12.4 km NE Moramanga, 18°50′22″S, 48°18′30″E, 1080 m, pitfall trap, 4–7 March 2007, B.L. Fisher (CASC PBI_OON 3843).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *andranomay* resemble those of *O. foulpointe* in having small eyes and very long and thin legs (figs. 141–142 [*andranomay*], 458–459 [*foulpointe*]), and *O.*



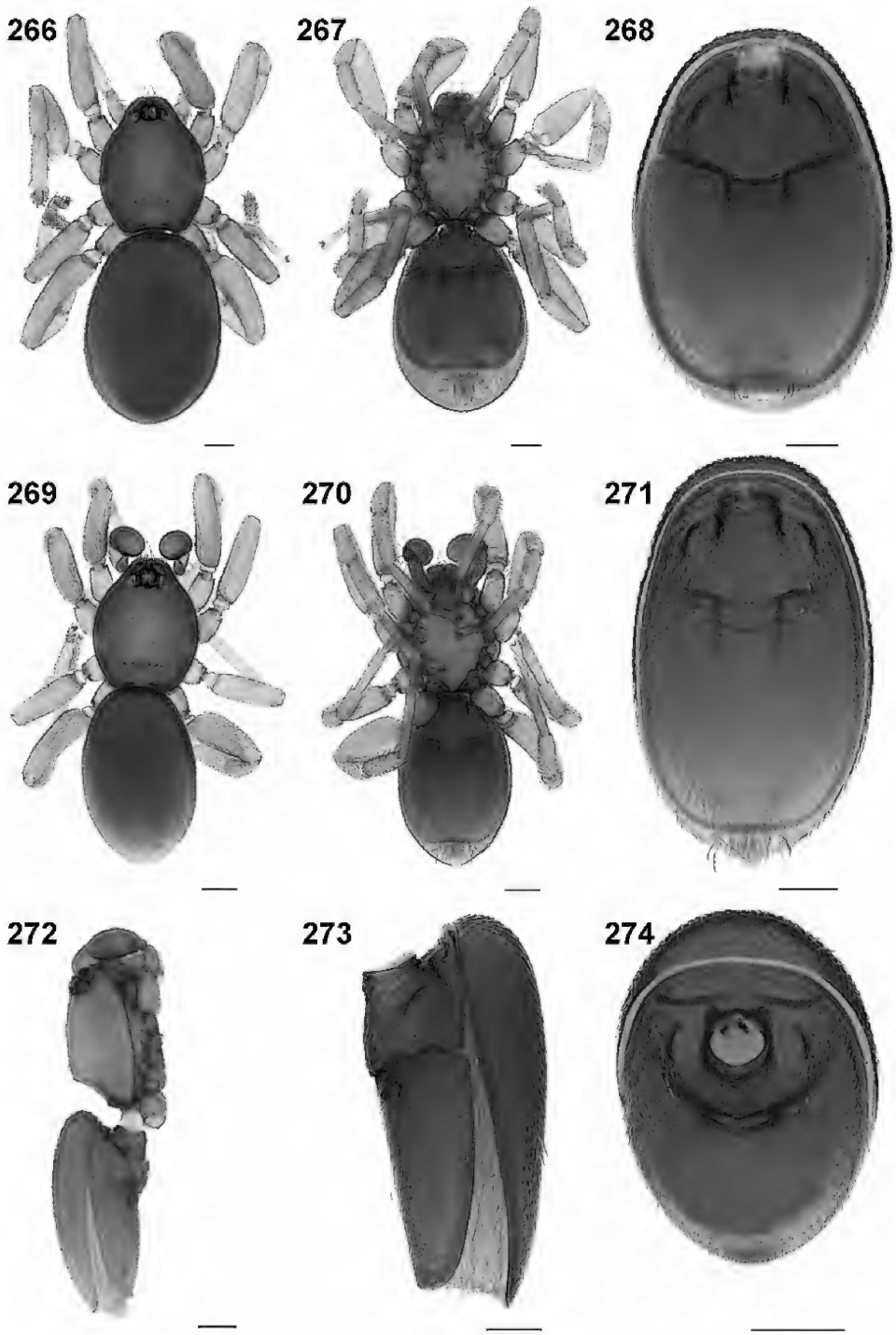
Figs. 256–262. *Opopaea ankarana,* n. sp. Male palp. **256.** Prolateral view. **257.** Retrolateral view. **258.** Close up, prolateral view. **259.** Retrolateral view. **260.** Anterior view. **261.** Embolar region, prolateral view. **262.** Retrolateral view. Scale bars: figures 256–260 = 20 μm; figures 261, 262 = 10 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.



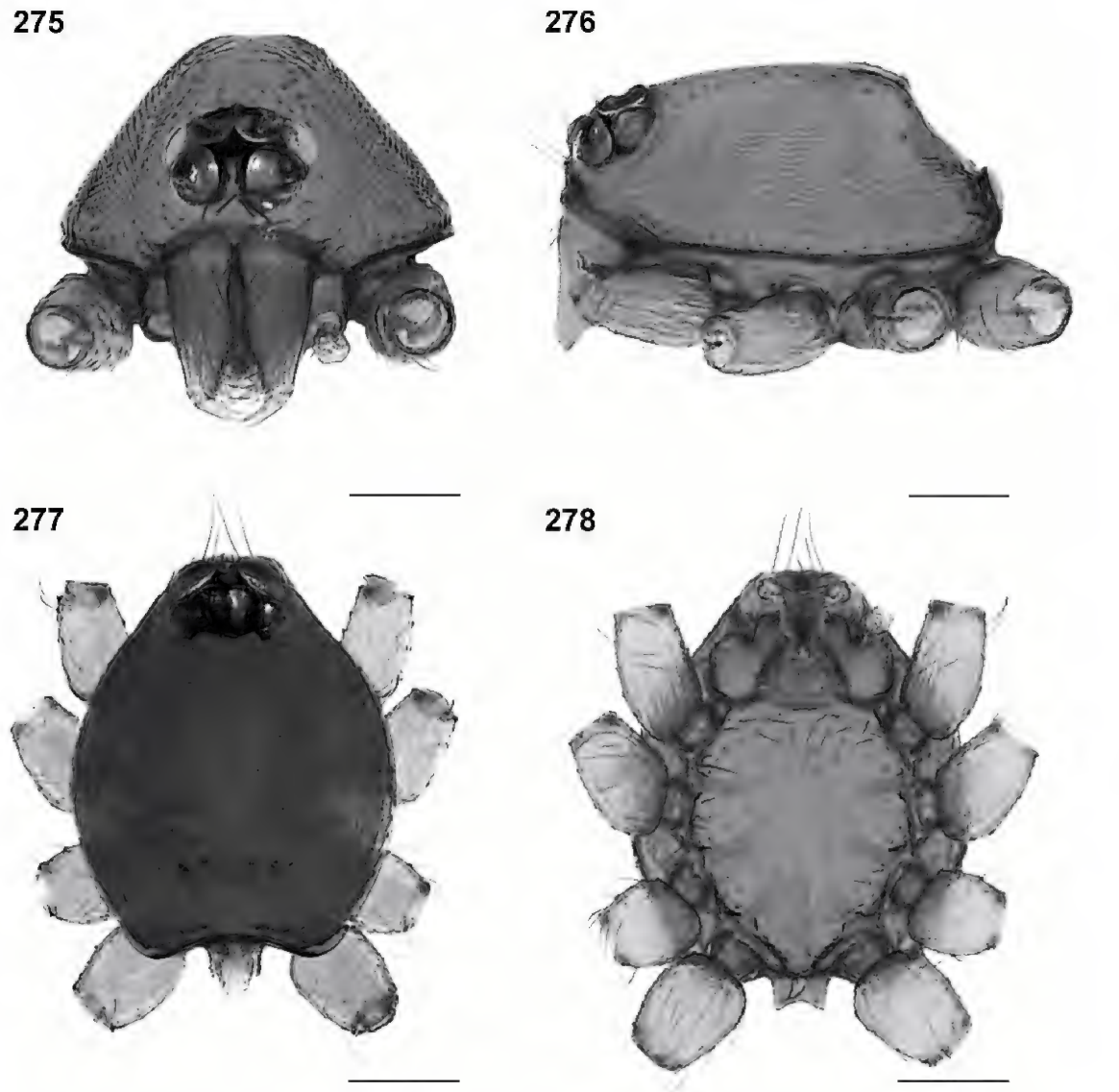
Figs. 263–265. *Opopaea antsalova,* n. sp. **263.** Male palp, prolateral view. **264.** Retrolateral view. **265.** Epigynum, dorsal view. Scale bars: 0.1 mm.

manongarivo, and *O. sandranantitra*, by having a cymbiobulbus almost the same length as the patella (figs. 151–152, 629–630, 731–732), but can be distinguished from other *Opopaea* species by the fenestra anterior top raised into a sclerotized dome, which abruptly and steeply slopes toward the tip (figs. 151–152, 155–156, 165–166). Females of *andranomay* can be easily recognized by a thick scutal ridge with a thick boatlike sclerotized median area bearing a small elliptical parmula (figs. 137, 157–158).

DESCRIPTION: Male (holotype) (PBI_OON 34422). Medium-sized to large species. Total length 1.71. Color: brown orange (figs. 141–144). Carapace: pars cephalica elevated posteriorly with one continuous row of four recurved denticles (figs. 148, 149). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Cheliceral paturon long and thin distally but heavier and bearing lateral boss proximally, usually detached from clypeus posterior margin and directed obliquely (figs. 147, 148). Eyes small. ALE largest. ALE oval, PME oval, PLE circular; PME darkened compared to other eyes; posterior eye row straight viewed from above, slightly procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide, with radial furrows between coxae; surface smooth, without pits, shape of posterior part between coxae IV hexagonal, not constricted. Lateral margins of area between coxae III unmodified, without lumps; setae abundant and evenly distributed, originating from surface, without hair tufts (fig. 150). Cymbiobulbus with a short sclerotized tip, and three protuberances: two on



Figs. 266–274. *Opopaea antsalova,* n. sp. **266.** Female, habitus, dorsal view. **267.** Habitus, ventral view. **268.** Abdomen, ventral view. **269.** Male, habitus, dorsal view. **270.** Habitus, ventral view. **271.** Abdomen, ventral view. **272.** Habitus, lateral view. **273.** Abdomen, lateral view. **274.** Anterior view. Scale bars: 0.2 mm.

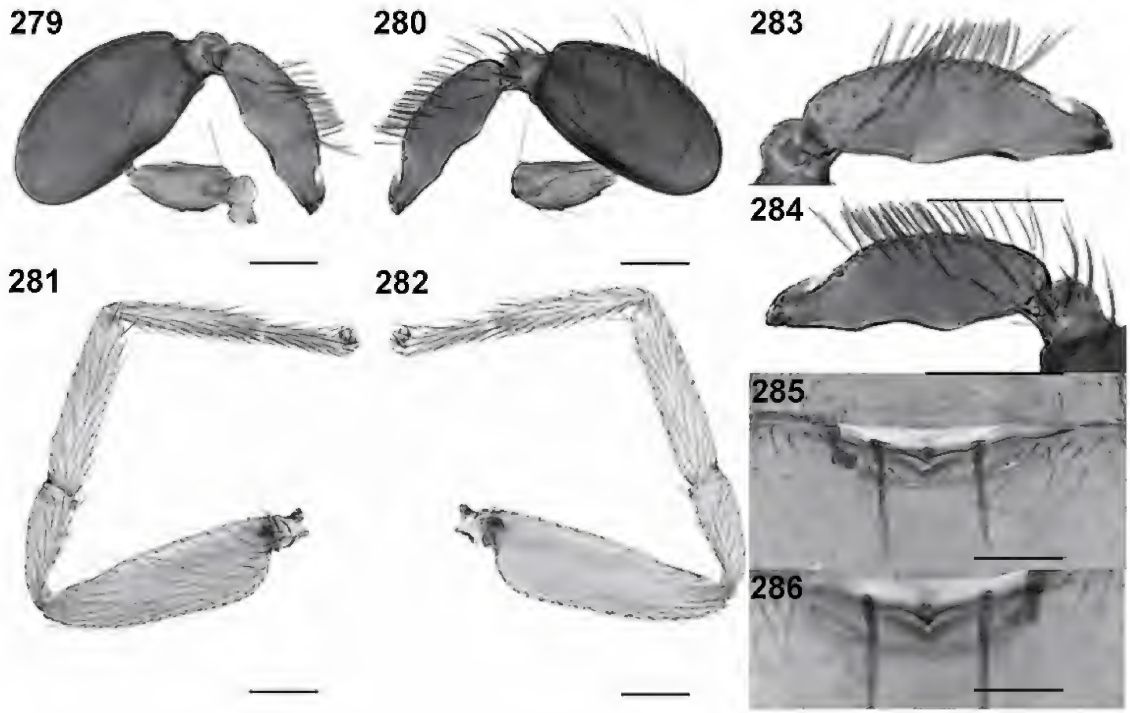


Figs. 275–277. *Opopaea antsalova,* n. sp., male. **275.** Carapace, anterior view. **276.** Lateral view. **277.** Dorsal view. **278.** Ventral view. Scale bars: 0.2 mm.

posterior margin (one small, distal and the other large, proximal) and one on retrolateral margin (figs. 152, 156). Palpal femora half the size of palpal patella and inserted almost medially to it. Fenestra large and located at the anterior part of the cymbiobulbus at one third of its length (figs. 135–136, 151–152, 155–156, 159–166).

Female (allotype) (PBI_OON 3843). Total length 1.91. Brown orange. Abdomen elongated, oval, and not flattened laterally toward posterior end (figs. 138–140). Epigynum postgynum depression short and narrow, with a thin and weakly sclerotized ridge (figs. 137, 157–158).

MEASUREMENTS: Male (holotype) (PBI_OON 34422). TL: 1.71; CL: 0.74; CW: 0.60; CH: 0.31; AL: 1.01; AW: 0.66; ALE: 0.08; PME: 0.08; PLE: 0.08; EGW: 0.22; ALE-ALE: 0.03; ALE-PLE: 0.02; PME-PME: 0; PLE-PME: 0; CBL: 0.25; CBW: 0.09; CBL/PTL: 0.80; FI: 0.11.



Figs. 279–286. *Opopaea antsalova,* n. sp. **279.** Male, palp, prolateral view. **280.** Retrolateral view. **281.** Leg IV, prolateral view. **282.** Retrolateral view. **283.** Male, palp, close up, prolateral view. **284.** Retrolateral view. **285.** Epigynum, ventral view. **286.** Dorsal view. Scale bars: figures 281, 282 = 0.2 mm; others = 0.1 mm.

Female (allotype) (PBI_OON 3843). TL: 1.91; CL: 0.77; CW: 0.60; CH: 0.28; AL: 1.13; AW: 0.79; ALE: 0.08; PME: 0.07; PLE: 0.06; EGW: 0.20; ALE-ALE: 0.04; ALE-PLE: 0.02; PME-PME: 0; PLE-PME: 0.01; EFL: 0.20; LAL: 0.09; PGI (LAL/EFL): 0.5; PDL/LAL: 0.55; PDW/EFL: 0.39.

VARIATION: Male: TL: 1.71–1.76; CL: 0.73–0.74; CW: 0.60–0.62; AL: 0.99–1.01; AW: 0.66–0.71.

NATURAL HISTORY: *O. andranomay* was mostly found in montane rainforest at high elevation (above 1000 m).

DISTRIBUTION: Mostly found along the central and eastern coast of Madagascar in the provinces of Antananarivo and Toamasina (Andranomay, Ambatovy) (map 1).

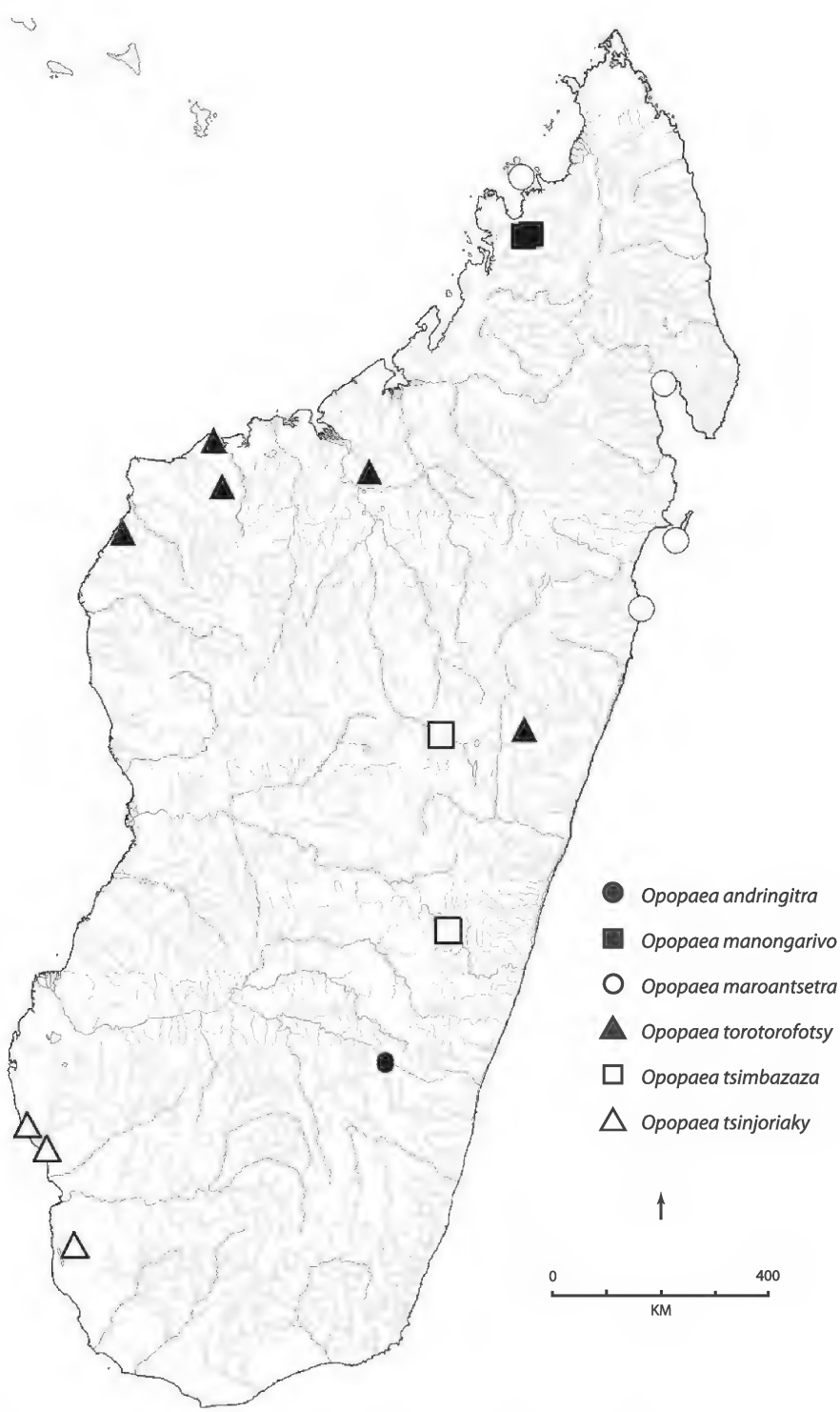
OTHER MATERIAL EXAMINED: MADAGASCAR: **Antananarivo:** 3 km 41° NE Andranomay, 11.5 km 147° SSE Anjozorobe, 18°28′24″S, 47°57′36″E, 1300 m, pitfall traps, montane rainforest, 05–13 December 2000, Fisher-Griswold Arthropod Team (CASC PBI_OON 35197), 7♂, 1♀ (CASC PBI_OON 34421), 1♂; (CASC PBI_OON 35030), 1♂; (CASC PBI_OON 34423), 1♂, 1♀ (CASC PBI_OON 34422), 7♂, 2♀. **Toamasina:** Ambatovy, 12.4 km NE Moramanga, 18°50′22″S, 48°18′30″E, 1080 m, pitfall trap, 4–7 March 2007. B.L. Fisher (CASC PBI_OON 3843), 1♂, 1♀.

Opopaea andringitra, new species
Figures 9, 22, 23, 25, 28, 33–38, 40, 44–46, 54–69, 71–73, 77–79, 89, 93, 99–100, 167–199; map 2

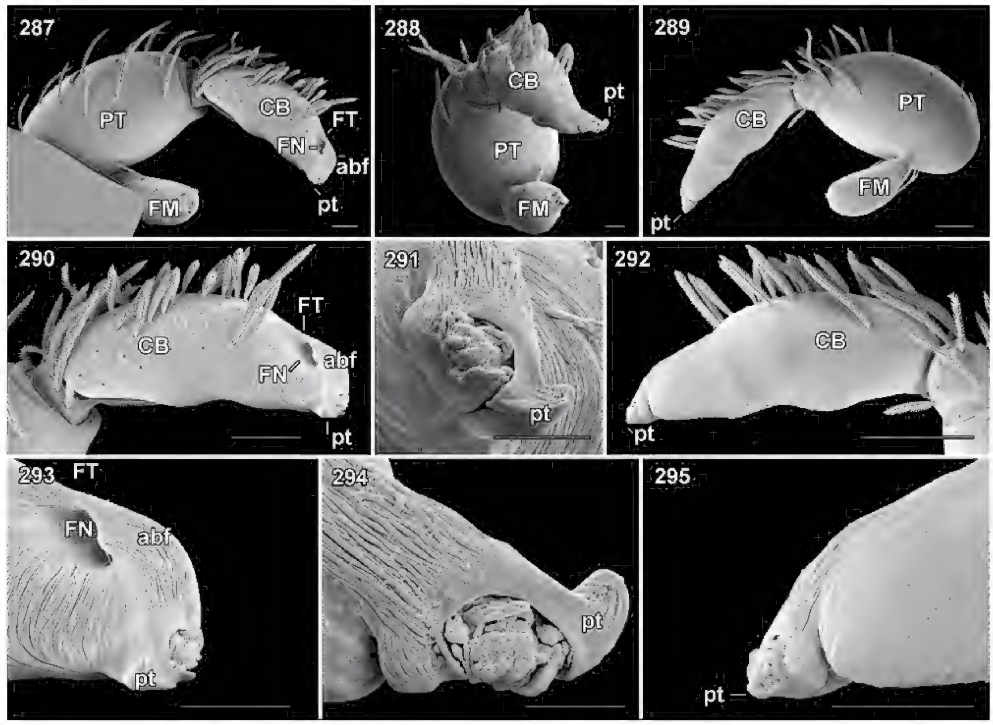
TYPES: Male holotype and female allotype from Fianarantsoa: Réserve Andringitra, 38 km S Ambalavao, 22°12′S, 46°58′E, 1680 m, EF19 sifted litter, rainforest. 23 October 1993, B.L. Fisher (CASC PBI_OON 34314), 1♂, 1♀.

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. andringitra* can most easily be distinguished from those of other *Opopaea* species by the rectangular



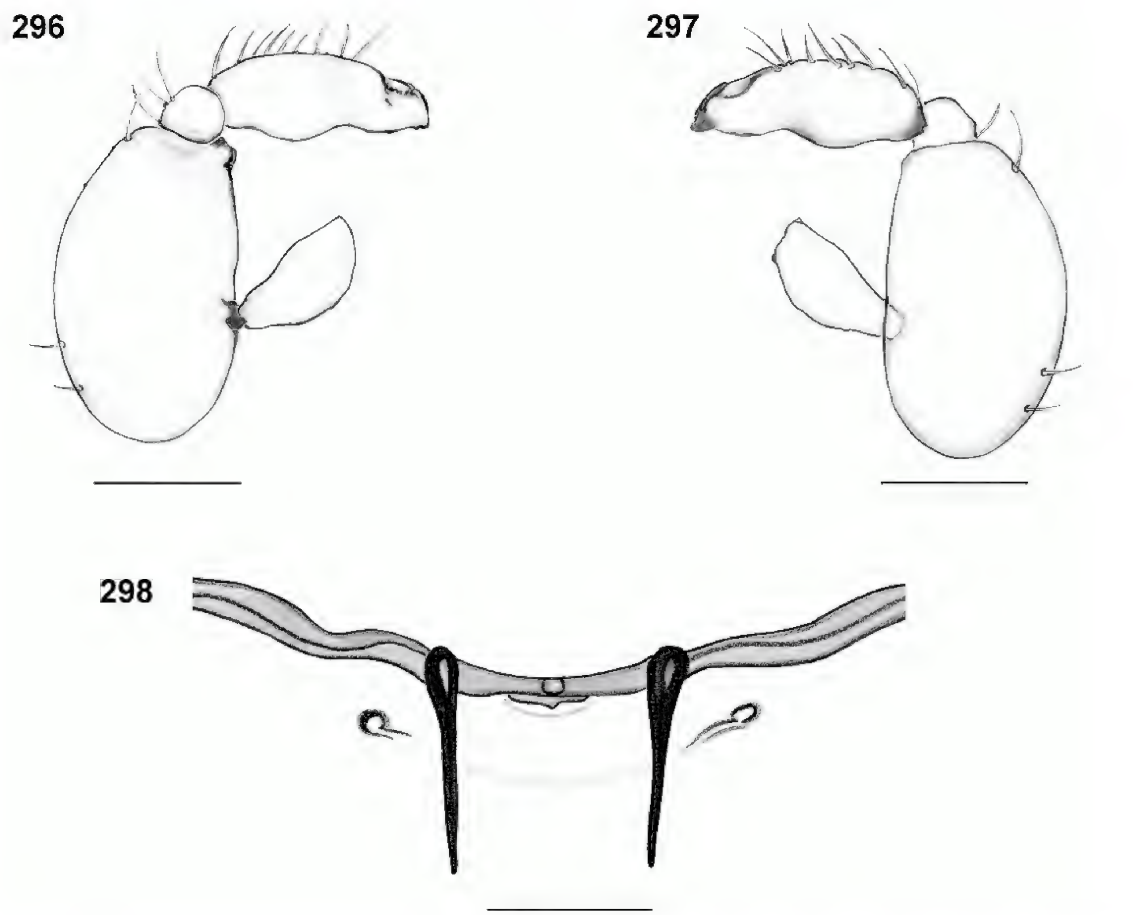
Map 2. Specimen records of *Opopaea* species in Madagascar: *O. andringitra, manongarivo, maroantsetra, torotorofotsy, tsimbazaza,* and *tsinjoriaky*.



Figs. 287–295. *Opopaea antsalova,* n. sp., male palp. **287.** Prolateral view. **288.** Anterior view. **289.** Retrolateral view. **290, 293.** Close up, prolateral view. **291.** Embolar region, anterior view. **292, 295.** Retrolateral view. **294.** Prolateral view. Scale bars: figures 287–290, 292 = 20 μm; 293–295 = 10 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

shape of the distal part of the cymbiobulbus, which is abruptly depressed dorsally, and the truncated palpal tip with two very short but sharp, sclerotized extensions (figs. 167–168, 183–184, 187–222). Females of *O. andringitra* can easily be recognized by a thick and divided scutal ridge, forming a reverse triangle medially and bearing a tiny, dark parmula anteriorly, and a short, sclerotized extension posteriorly (figs. 169, 189–190).

DESCRIPTION: Male (holotype) (PBI_OON 35038). Large species. Total length 1.73. Color: orange. Carapace: pars cephalica elevated posteriorly with one row of four continuous hairs, carapace anteriorly narrowed to about one third its maximum width (figs. 180, 181). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes large. ALE largest. ALE and PLE oval, PME squared; PME darkened compared to other eyes; posterior eye row straight viewed from above, procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth and shiny, without pits, shape of posterior part between coxae IV hexagonal, more or less narrow. Lateral margins of area between coxae III unmodified, without lumps; setae more or less abundant, dark, needlelike, evenly distributed, originating from surface, without hair tufts (fig. 182). Abdomen oval and not flattened laterally toward posterior end. Palp posterior margin more or less straight with two posterior protuberances: a wide and smooth proximal one and a sharply pointed and small distal one (figs. 183–187). Palpal femora half the size of palpal patella and inserted more or less medially to it. Palpal



Figs. 296–298. *Opopaea antsiranana,* n. sp. **296.** Male palp prolateral view. **297.** Retrolateral view. **298.** Epigynum, dorsal view. Scale bars: 0.1 mm.

fenestra round, large and located near the tip of the palp, fenestral top not raised (figs. 167–168, 183–184, 191–199).

Female (allotype) (PBI_OON 35038). Total length 2.04. Orange, abdomen oval, and not flattened posteriorly. Postgynum depression short and narrow, postgynum depression ridge weakly sclerotized posteriorly (figs. 169, 189–190).

MEASUREMENTS: Male (holotype) (PBI_OON 35038). TL: 1.73; CL: 0.81; CW: 0.66; CH: 0.44; AL: 1; AW: 0.72; ALE: 0.10; PME: 0.10; PLE: 0.09; EGW: 0.27; ALE-ALE: 0.02; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; CBL: 0.25; CBW: 0.10; CBL/PTL: 0.60; FI: 0.16.

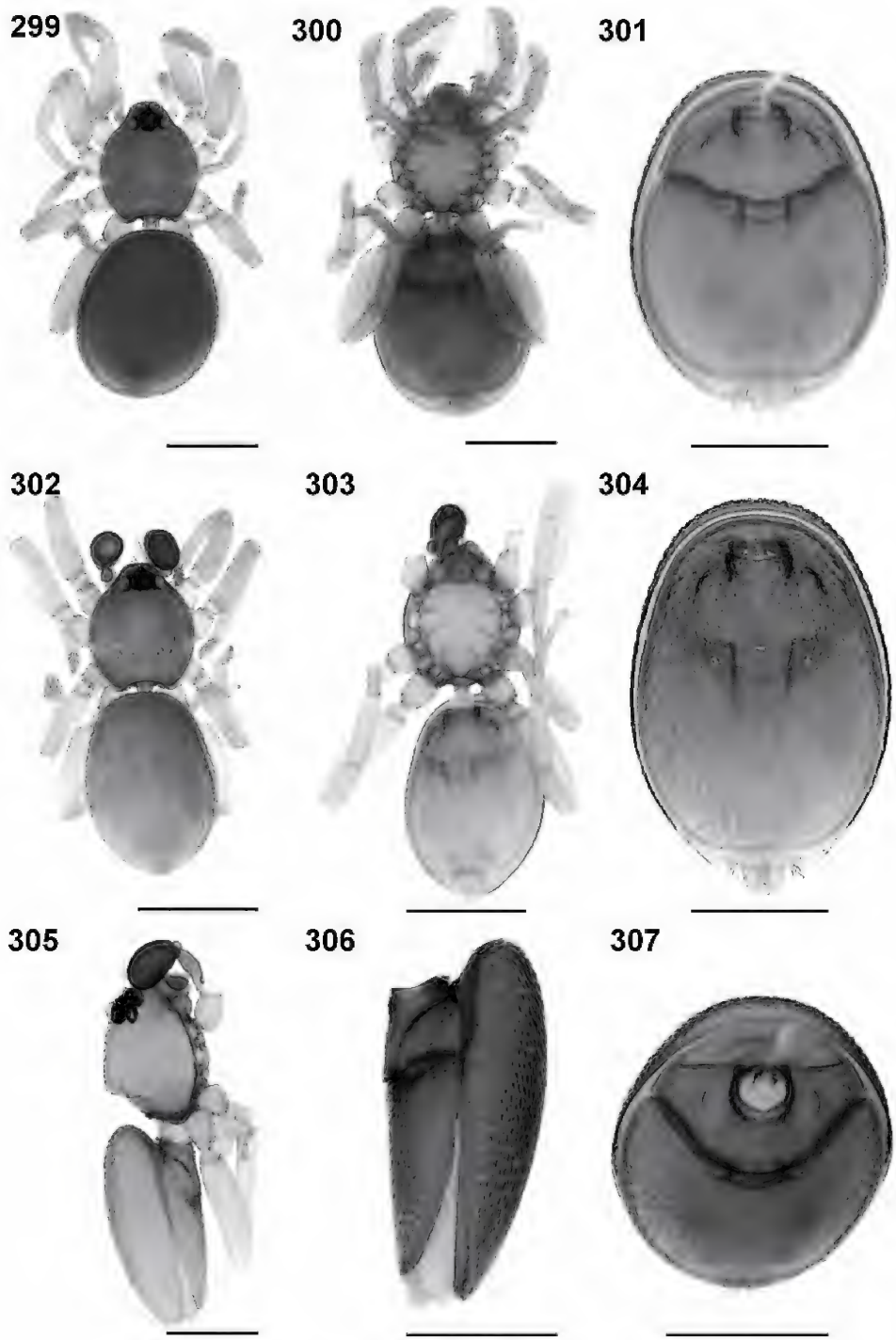
Female (allotype) (PBI_OON 35038). TL: 2.04; CL: 0.85; CW: 0.66; CH: 0.46; AL: 1.25; AW: 0.94; ALE: 0.11; PME: 0.09; PLE: 0.08; EGW: 0.26; ALE-ALE: 0.02; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; EFL: 0.23; LAL: 0.11; PGI (LAL/EFL): 0.48; PDL/LAL: 0.45; PDW/EFL: 0.35.

VARIATION: Female: TL: 2.02–2.06; CL: 0.82–0.85; CW: 0.66–0.68; AL: 1.25–1.28; AW: 0.85–0.94.

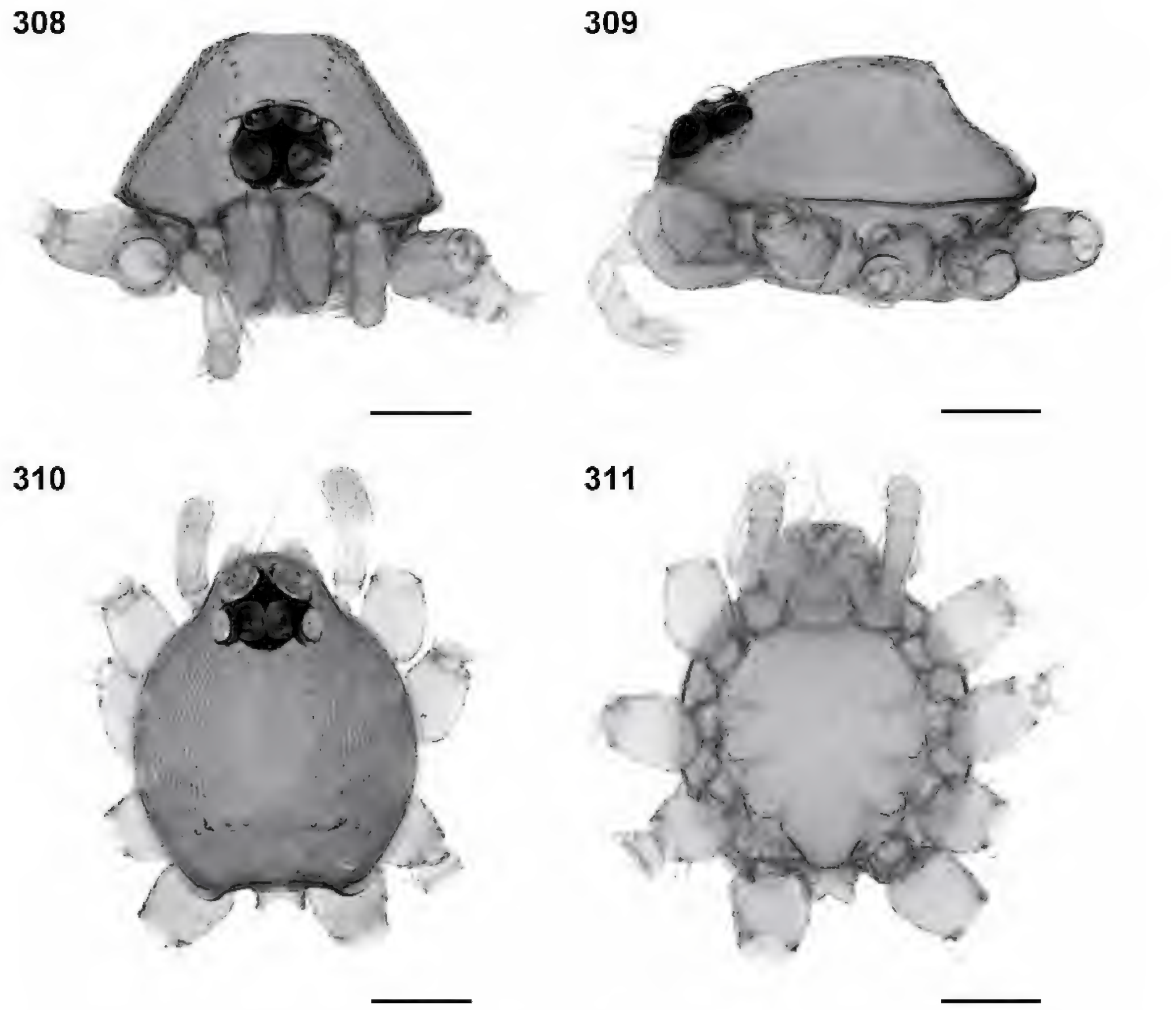
NATURAL HISTORY: *O. andringitra* was mostly found in montane rainforest at high elevations (1680–1990 m).

DISTRIBUTION: *O. andringitra* was mostly found in south-central Madagascar in the province of Fianarantsoa (Andringitra) (map 2).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Fianarantsoa:** Réserve Andringitra, 38 km S Ambalavao, 22°12′S, 46°58′E, 1680 m, EF19 sifted litter, rainforest, 23 October 1993, B.L. Fisher (CASC PBI_OON



Figs. 299–307. *Opopaea antsiranana,* n. sp. **299.** Female, habitus, dorsal view. **300.** Habitus, ventral view. **301.** Abdomen, ventral view. **302.** Male, habitus, dorsal view. **303.** Habitus, ventral view. **304.** Abdomen, ventral view. **305.** Habitus, lateral view. **306.** Abdomen, lateral view. **307.** Anterior view. Scale bars: 0.2 mm.



Figs. 308–311. *Opopaea antsiranana,* n. sp., female. **308.** Carapace, anterior view. **309.** Lateral view. **310.** Dorsal view. **311.** Ventral view. Scale bars: 0.2 mm.

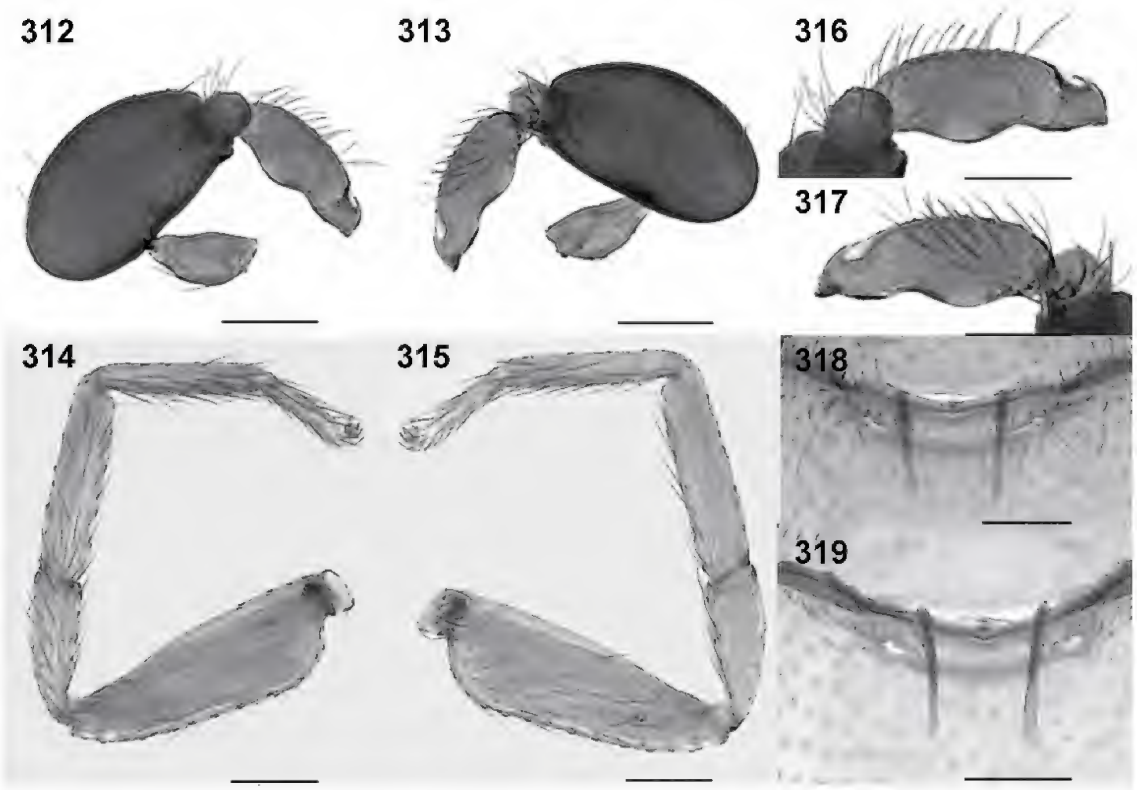
3072), 1♀ (CASC PBI_OON 3108), 1♀ (CASC PBI_OON 3135), 1♀ (CASC PBI_OON 3076), 1♀ (CASC PBI_OON 3121), 1♀. 1975 m, sifted litter (leaf mold, rotten wood), montane rainforest, 29 October 1993, B.L. Fisher (CASC PBI_OON 3081), 1♀. 8.5 km SE Antanitotsy, 22°10′S, 46°58′E. 1990 m, sifting litter, rainforest, 06 March 1997, B.L. Fisher (CASC PBI_OON 3134), 1♀.

Opopaea ankarafantsika, new species
Figures 11, 12, 30, 31, 80, 200–231; map 1

TYPES: Male holotype and female allotype from Mahajanga: PN Ankarafantsika, Ampijoroa station forestière, 5.4 km 331° NW Andranofasika, 16°17′56″S, 46°48′47″E, 70 m elevation, 26 March–01 April 2001, tropical dry forest, EF19 sifted litter, coll. Fisher and Griswold, et al., BLF3571 (CASC PBI_OON 3144).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. ankarafantsika* resemble those of *O. andringitra* in having a long, narrow cymbiobulbus (figs. 216–217, 183–184, respectively). However, it can be distinguished from all other *Opopaea* species by having a more or less straight cymbiobulbus tapering anteriorly, with posterior margin without protuberances (figs. 224–226). Females of *ankarafantsika* can be recognized by a wide, divided, and medially lowered



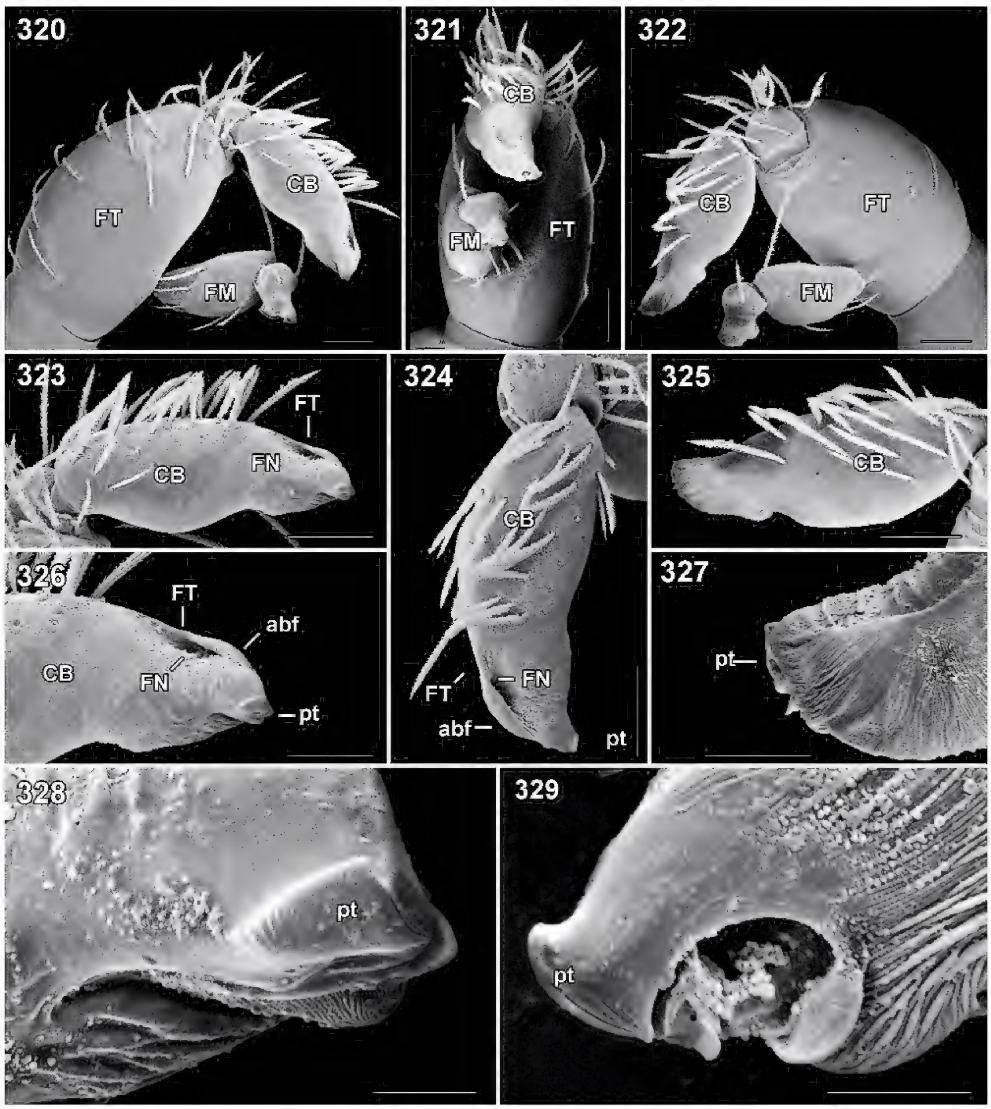
Figs. 312–319. *Opopaea antsiranana,* n. sp. **312.** Male, palp, prolateral view. **313.** Retrolateral view. **314.** Leg IV, prolateral view. **315.** Retrolateral view. **316.** Male, palp close up, prolateral view. **317.** Retrolateral view. **318.** Epigynum, ventral view. **319.** Dorsal view. Scale bars: figures 314, 315 = 0.2 mm; others = 0.1 mm.

scutal ridge bearing a small oval parmula and by a narrow postgynum depression (figs. 202, 222–223).

DESCRIPTION: Male (holotype) (PBI_OON 3144). Large species. Total length 2.14. Color: dark orange. Carapace: pars cephalica flat in lateral view with one row of two sets of three small denticles (figs. 213–214), anteriorly narrowed to one third its maximum width. Carapace anterolateral corners without sclerotized, triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes large. ALE largest. ALE circular, PME squared, PLE oval; PME darkened compared to other eyes; posterior eye row straight viewed from above, straight from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, shape of posterior part between coxae IV hexagonal. Lateral margins of area between coxae III unmodified, without lumps, setae sparse, dark, needlelike, densest laterally, originating from surface, without hair tufts (fig. 215). Abdomen oval and flattened laterally toward posterior end. Palp fenestra round and small located toward the anterior end of the palp, fenestral top barely raised toward the tip (figs. 200–201, 216–217, 220–221, 224–231).

Female (allotype) (PBI_OON 3144). Total length 2.32. Postgynum ridge thin and slightly sclerotized (figs. 202, 222–223).

MEASUREMENTS: Male (holotype) (PBI_OON 3144). TL: 2.14; CL: 0.92; CW: 0.71; CH: 0.46; AL: 1.17; AW: 0.74; ALE: 0.13; PME: 0.11; PLE: 0.09; EGW: 0.26; ALE-ALE: 0.01; ALE-PLE: 0; PME-PME: 0; PLE-PME: 0; CBL: 0.29; CBW: 0.11; CBL/PTL: 0.91; FI: 0.10.



Figs. 320–329. *Opopaea antsiranana,* n. sp., male palp. **320.** Prolateral view. **321.** Anterior view. **322.** Retrolateral view. **323, 326.** Close up, prolateral view. **324.** Dorsal view. **325.** Close up, retrolateral view. **327.** Embolar region, retrolateral view. **328.** Prolateral view. **329.** Anterior view. Scale bars: figures 320–322 = 40 μm; figures 323–326 = 30 μm; figure 327 = 10 μm; figures 328–329 = 4 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

Female (allotype) (PBI_OON 3144). TL: 2.32; CL: 0.96; CW: 0.76; AL: 1.38; AW: 0.98; EFL: 0.24; LAL: 0.10; PGI: 2.45; LAL/PDL: 2.55; EFL/PDW: 5.28.

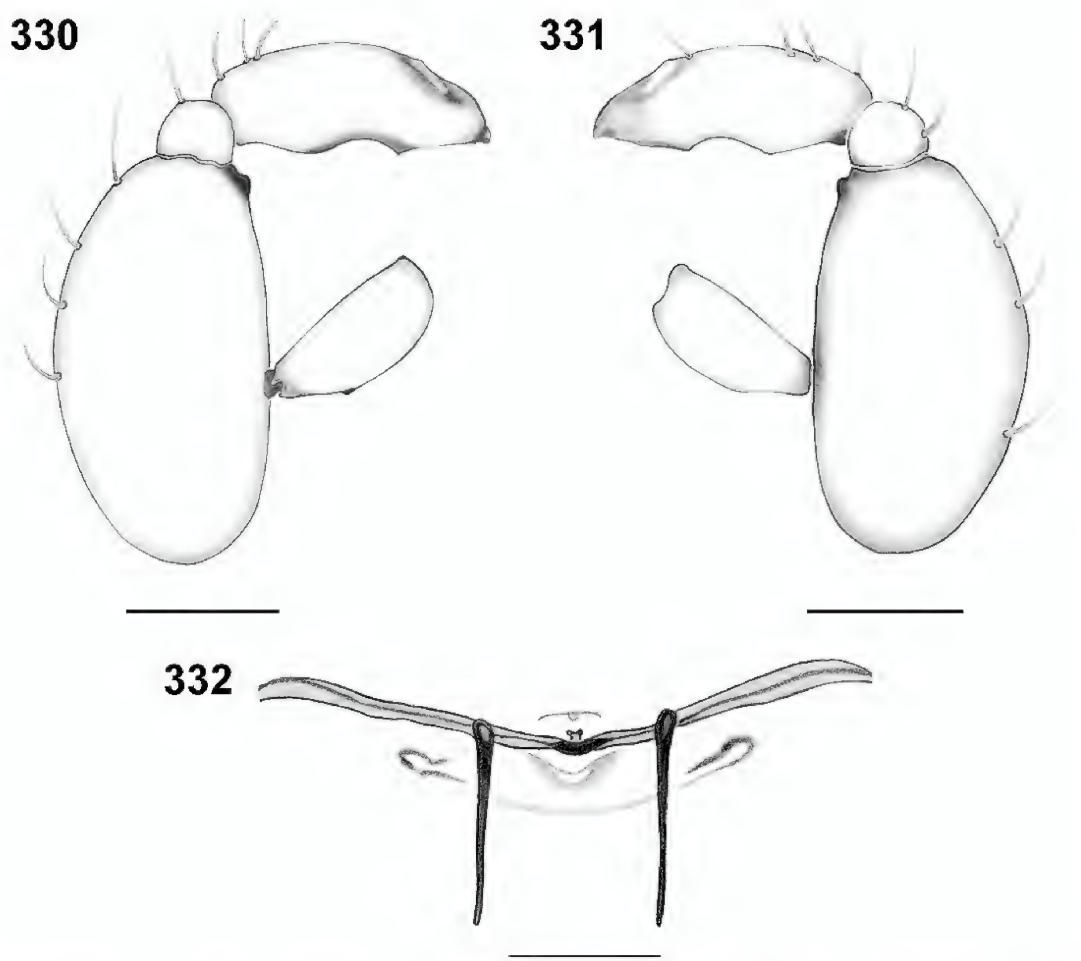
VARIATION: Male: TL: 1.57–2.14; CL: 0.84–0.92; CW: 0.64–0.71; AL: 1.08–1.17; AW: 0.68–0.74.

Female: TL: 2.32–2.36; CL: 0.94–0.98; CW: 0.72–0.75; AL: 0.38–0.47; AW: 0.91–0.98.

NATURAL HISTORY: *O. ankarafantsika* was found in tropical dry forest at low elevations (70–140 m).

DISTRIBUTION: *O. ankarafantsika* was mostly found in the southern Madagascar, in the provinces of Mahajanga and Toliara (Ankarafantsika, Namoroka, Beza-Mahafaly) (map 1).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Mahajanga:** PN Ankarafantsika,

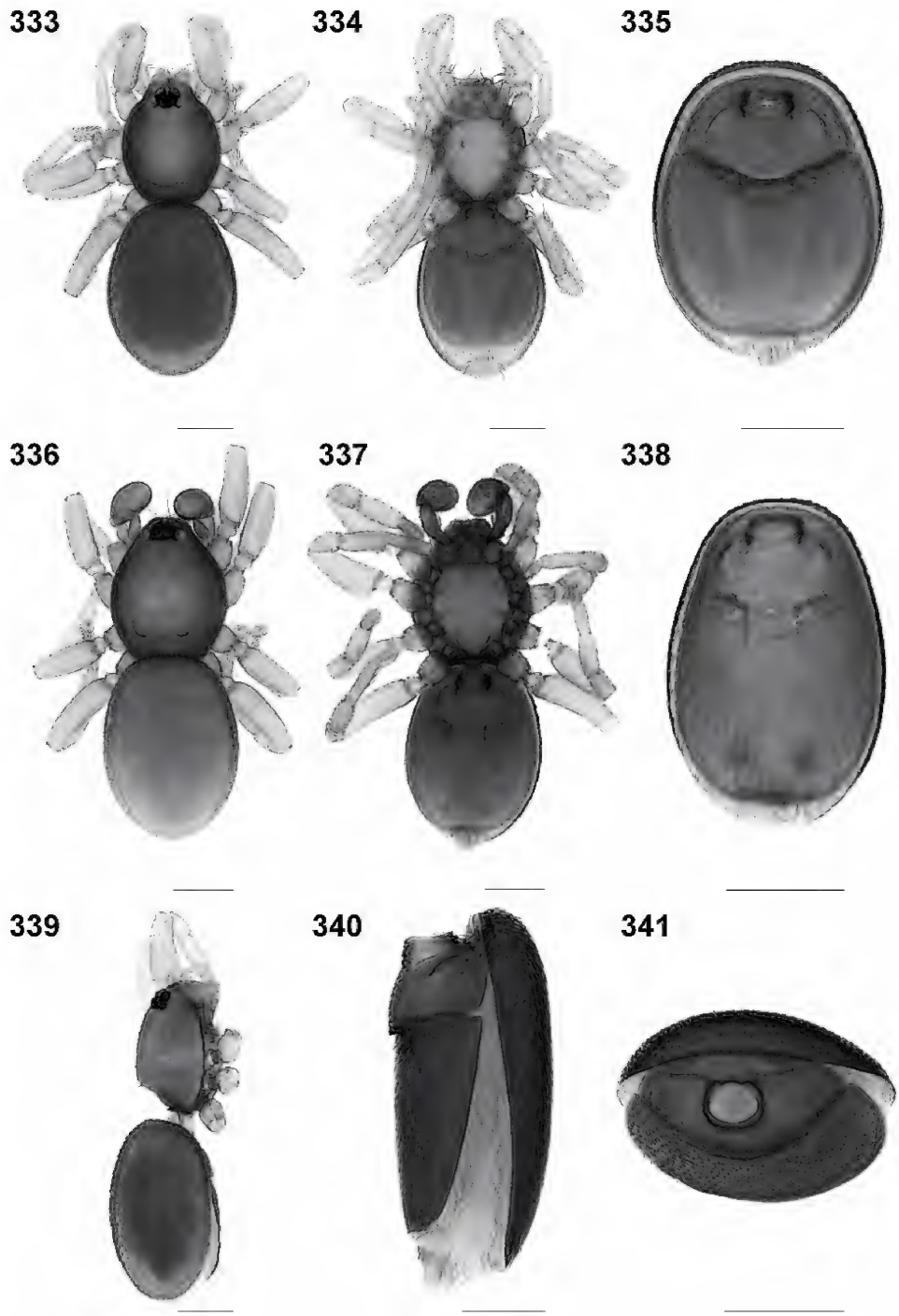


Figs. 330–332. *Opopaea bemaraha,* n. sp. **330.** Male, palp, prolateral view. **331.** Retrolateral view. **332.** Epigynum, dorsal view. Scale bars: 0.1 mm.

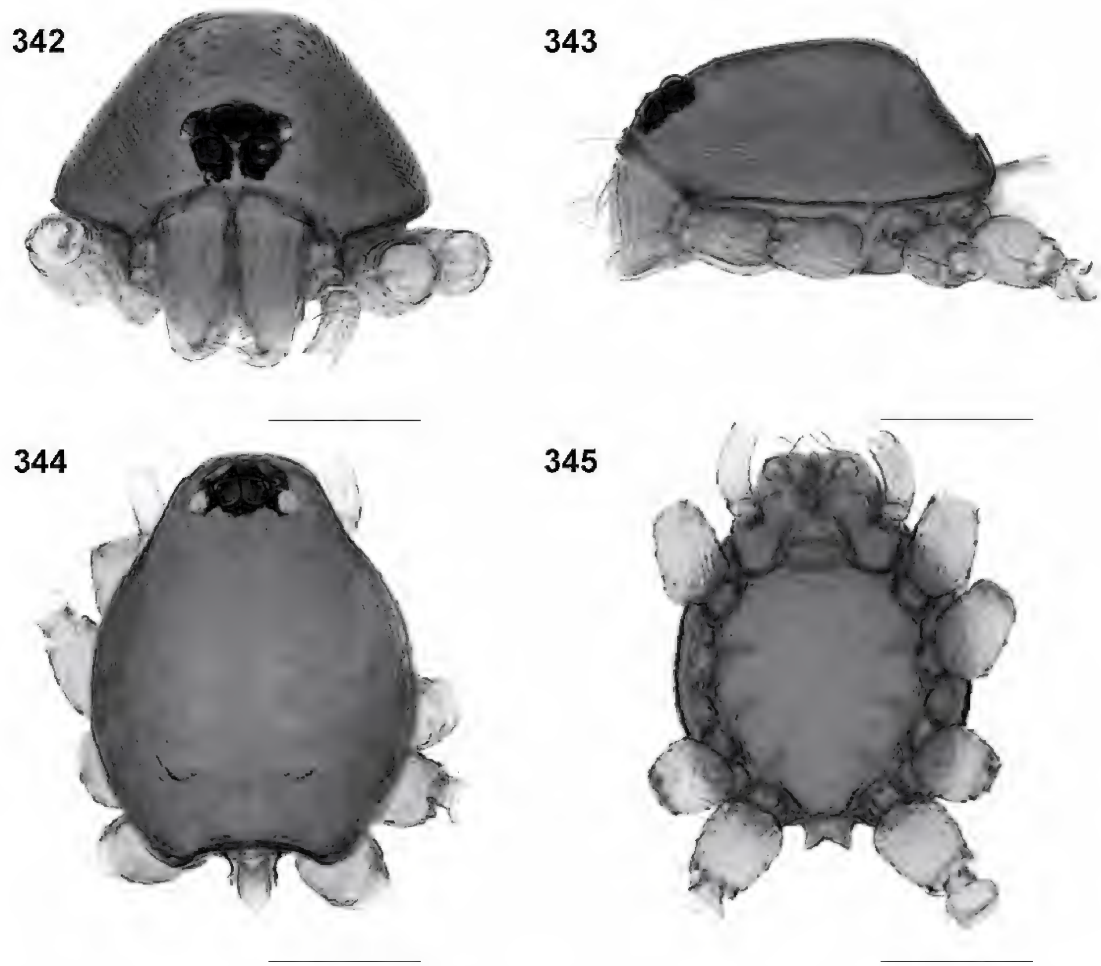
Forêt de Tsimaloto, 18.3 km 46° NE de Tsaramandroso, S16°13′41″, E46°8′37″, 135 m elevation, 2–8 April 2001, tropical dry forest, EF19 sifted litter, coll. Fisher andGriswold et al., BLF3599 (CASC PBI_OON 3101), 6♂, 9♀. Park national Namoroka, 9.8 km 300° WNW Vilanandro, S16°28′, E45°21′, 140 m elevation, 4–8 November 2002, tropical dry forest, EF19 sifted litter, mold, rotten wood, C. Griswold and B. Fisher, et al. (CASC PBI_OON 37700), 2♂, 4♀). **Mahajanga:** PN Ankarafantsika, Ampijoroa station forestière, 5.4 km 331° NW Andranofasika, S16°17′56″, E46°48′47″, 70 m elevation, 26 March–01 April 2001, tropical dry forest, EF19 sifted litter, coll. Fisher andGriswold et al., BLF3571 (CASC. PBI_OON 3144), 1♀. **Toliara:** RS Beza Mahafaly, 26.19 km ENE Betioky, S23°39′18.2″, E44°37′58.8′, 147 m elevation, 18 Jan 2009, gallery forest, sifting, D. Andriamalala, C. Griswold, G. Hormiga, A. Saucedo, N. Scharff, and H. Wood (PBI_OON 35232), 1♀.

Opopaea ankarana, new species
Figures 19, 24, 49; 98, 232–262; map 1

TYPES: Male holotype and female allotype from Antsiranana: Réserve spéciale de l'Ankarana, 13.6 km 192° SSW Anivorano Nord, 12°51′49″S, 49°13′33″E, 210 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 16–20 February 2001, coll. Fisher and Griswold, et al. (CASC. PBI_OON 2004).



Figs. 333–341. *Opopaea bemaraha,* n. sp. **333.** Female, habitus, dorsal view. **334.** Habitus, ventral view. **335.** Abdomen, ventral view. **336.** Male, habitus, dorsal view. **337.** Habitus, ventral view. **338.** Abdomen, ventral view. **339.** Habitus, lateral view. **340.** Abdomen, lateral view. **341.** Abdomen, anterior view. Scale bars: 0.2 mm.

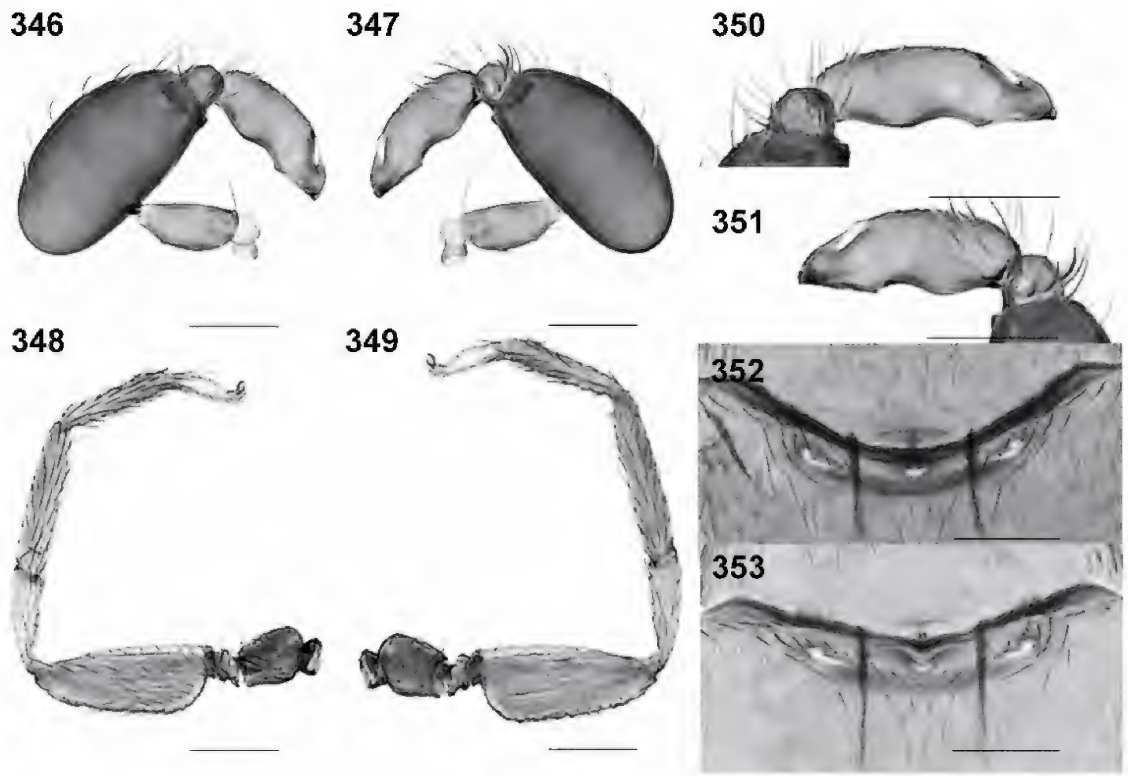


Figs. 342–345. *Opopaea bemaraha,* n. sp., female. **342.** Carapace, anterior view. **343.** Lateral view. **344.** Dorsal view. **345.** Ventral view. Scale bars: 0.2 mm.

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. ankarana* can be most easily distinguished from those of other *Opopaea* species by the tip of the cymbiobulbus large, round, pointing downward, thinner on prolateral side, with a very short sclerotized extension directed on the prolateral side (figs. 232–233, 248–249, 252–253, 256–262). Females of *O. ankarana* can be easily recognized by a thick and straight scutal ridge, not divided and bearing a large median parmula (figs. 234, 254–255).

DESCRIPTION: Male (holotype) (PBI_OON 2004). Small species. Total length 1.26. Color: orange to yellowish orange. Carapace: pars cephalica elevated posteriorly with one row of two sets of two denticles, carapace anteriorly narrowed to about one third its maximum width (figs. 245–246). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes large. ALE, PME, and PLE subequal, ALE and PLE oval, PME squared; PME darkened compared to other eyes; posterior eye row straight or slightly procurved from above, procurved from front; ALE separated by their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum slightly longer than wide with radial furrows between coxae; surface smooth and more or less hairy,



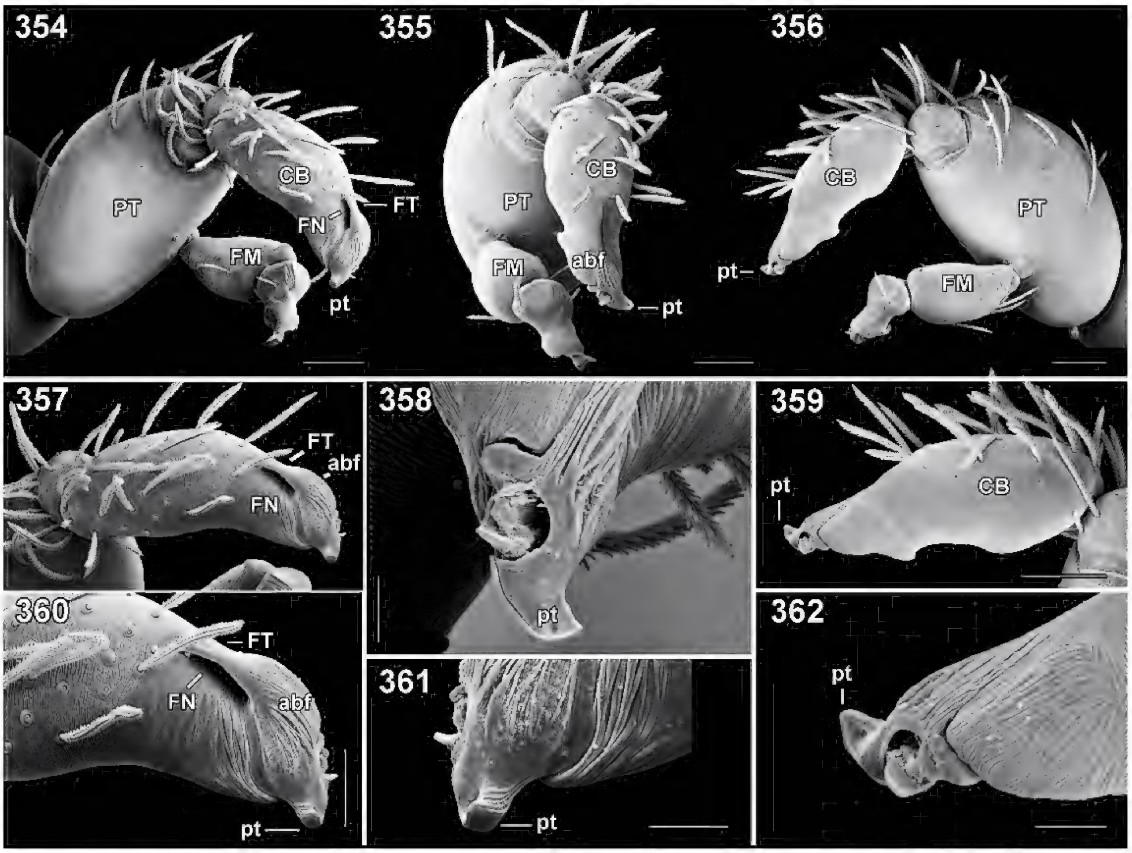
Figs. 346–353. *Opopaea bemaraha,* n. sp. **346.** Male, palp, prolateral view. **347.** Retrolateral view. **348.** Leg IV, prolateral view. **349.** Leg IV, retrolateral view. **350.** Male, palp, close up, prolateral view. **351.** Retrolateral view. **352.** Epigynum, ventral view. **353.** Dorsal view. Scale bars: figures 348, 349 = 0.2 mm; others = 0.1 mm.

without pits, posterior part between coxae IV slightly constricted into a short rectangle, which is slightly sclerotized toward posterior edge, median part swollen into an elongated, sharply raised, and sclerotized lump (fig. 247). Area between coxae III unmodified, lateral margins without lumps. Sternum setae more or less abundant, dark, needlelike, evenly distributed, originating from surface, without hair tufts. Abdomen oval and not flattened laterally toward posterior end. Palp posterior margin with two huge, smooth protuberances and slightly curved downward (figs. 252, 256). Palpal femora less than half the size of palpal patella and inserted at one third its length. Palpal fenestra round, large, and enlarged anteriorly, located at one third the palp, fenestra top sclerotized and greatly raised toward the tip (figs. 232–233, 248–249, 252–253, 256–262).

Female (allotype) (PBI_OON 2004). Total length 1.66. Orange to yellowish orange, abdomen oval, and not flattened posteriorly. Postgynum depression short and narrow, ridge sclerotized, more or less thick (figs. 234, 254–255).

MEASUREMENTS: Male (holotype) (PBI_OON 2004). TL: 1.26; CL: 0.59; CW: 0.50; CH: 0.24; AL: 0.72; AW: 0.52; ALE: 0.07; PME: 0.07; PLE: 0.07; EGW: 0.20; ALE-ALE: 0.02; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; CBL: 0.20; CBW: 0.08; CBL/PTL: 0.80; FI: 0.11.

Female (allotype) (PBI_OON 2004). TL: 1.66; CL: 0.69; CW: 0.55; CH: 0.27; AL: 1.02; AW: 0.75; ALE: 0.09; PME: 0.08; PLE: 0.07; EGW: 0.21; ALE-ALE: 0.02; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; EFL: 0.16; LAL: 0.07; PGI (LAL/EFL): 0.44; PDL/LAL: 0.43; PDW/EFL: 0.31.



Figs. 354–362. *Opopaea bemaraha,* n. sp., male palp. **354.** Prolateral view. **355.** Anterior view. **356.** Retrolateral view. **357, 360.** Close up, prolateral view. **358.** Embolar region, anterior view. **359, 362.** Close up, retrolateral view. **361.** Embolar region, prolateral view. Scale bars: figures 354–356 = 30 μm; figures 357, 359 = 20 μm; figures 358, 360–362 = 10 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

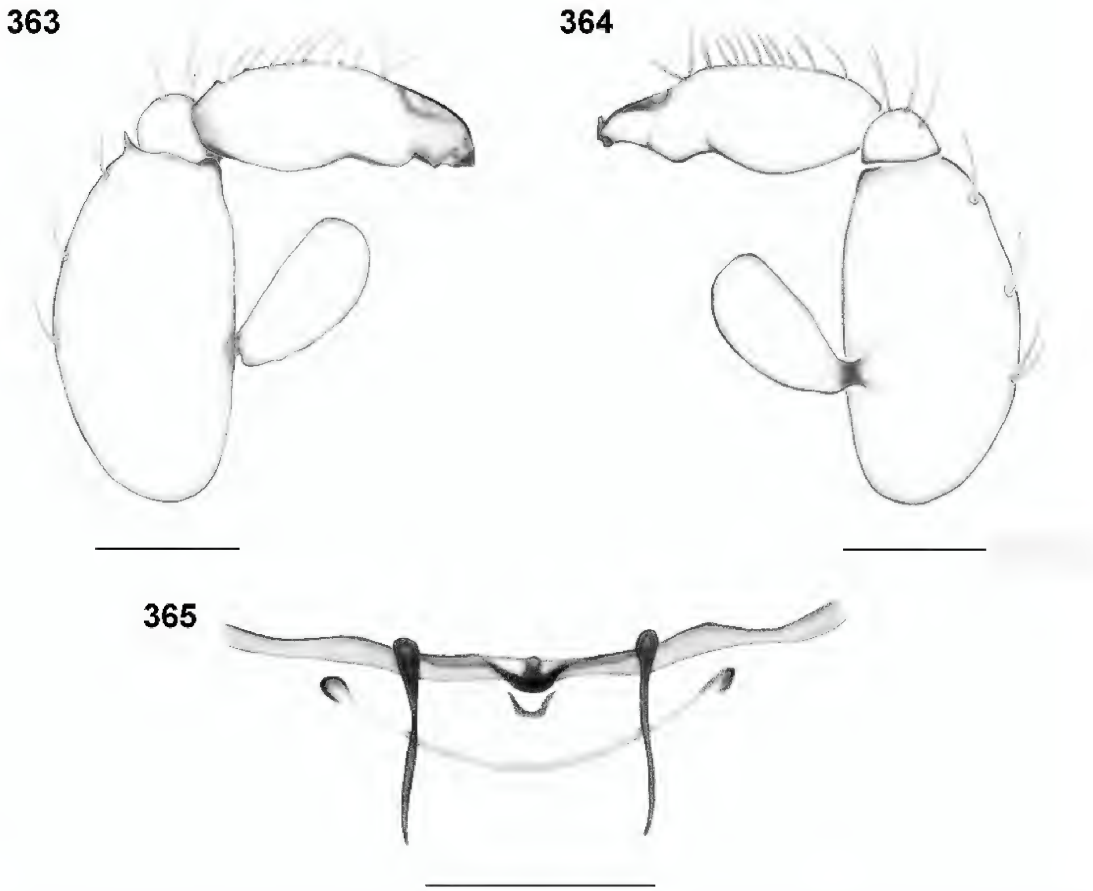
VARIATION: Male: TL: 1.26–1.33; CL: 0.59–0.60; CW: 0.48–0.50; AL: 0.72–0.79; AW: 0.51–0.52.

Female: TL: 1.54–1.66; CL: 0.67–0.69; CW: 0.54–0.55; AL: 1–1.02; AW: 0.75–0.75.

NATURAL HISTORY: *O. ankarana* was mostly found in tropical dry forest and rainforest at low elevations (30–180 m).

DISTRIBUTION: *O. ankarana* was mostly found in northern Madagascar in the province of Antsiranana (Ankarana, Montagne des Français, Lokobe, Bekaraoka) (map 1).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Antsiranana:** Réserve spéciale de l'Ankarana, 22.9 km 224° SW Anivorano Nord, camp anglaise, 12.90889°S, 49.10983°E, 80 m, general collecting, tropical dry forest, 10–16 February 2001, L.J. Boutin coll. (CASC PBI_OON 3147), 2♂, 1♀. 12° 54′32″S, 49°6′3″E, 80 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 10–16 February 2001, coll. Fisher andGriswold et al., BLF2858 (CASC PBI_OON 34973), 25♂, 40♀. 12° 54′S, 49°6′E, 150 m, general collecting, August 1992, G. Alpert (MZC PBI_OON 28202), 1♂, 1♀. 13.6 km 192° SSW Anivorano Nord, 12°51′49″S, 49°13′33″E, 210 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 16–20 February 2001, coll. Fisher and Griswold et al. (CASC PBI_OON 2004), 40♂, 51♀. Montagne des Français, 7.2 km, 142° SE Antsiranana (= Diego Suarez), 12°19′22″S, 49°20′17″E, 180 m, EF22 pitfall trap, tropical dry forest, 22–28 February 2001, coll. Fisher andGriswold et al., BLF3123 (CASC PBI_OON 350450), 1♂. 12.32278°S,



Figs. 363–365. *Opopaea bemarivo,* n. sp. **363.** Male, palp prolateral view. **364.** Retrolateral view. **365.** Epigynum, dorsal view. Scale bars: 0.1 mm.

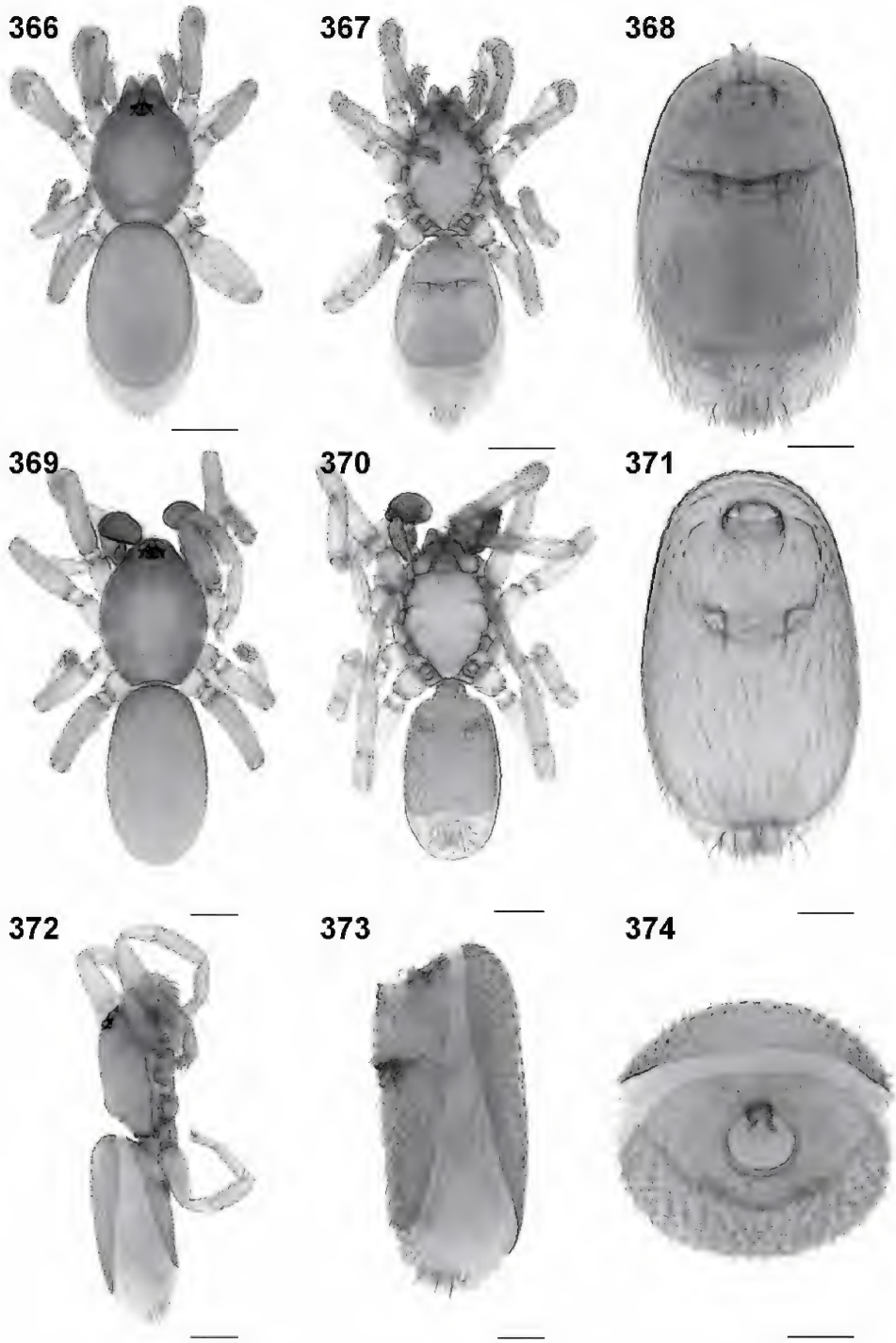
49.33817°E, 180 m, general collecting, 23–25 February 2001, L.J. Boutin coll. (CASC PBI_OON 3130), 2♂, 1♀. Nosy Be Réserve Naturelle Intégrale de Lokobe, 6.3 km 112° ESE Hellville, 13°25′10″S, 48°19′52″E, 30 m, EC277 pitfall trap, rainforest, 19–24 Mars 2001, coll. Fisher and Griswold et al., BLF3418 (CASC PBI_OON 3140), 1♂. Forêt Bekaraoka, 6.8 km 60° ENE Daraina, 13°10′00″S, 49°42′36″E, 150 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 07 December 2003, coll. B.L. Fisher et al., BLF9872 (CASC PBI_OON 3787), 15♂, 13♀.

Opopaea antsalova, new species
Figures 7, 8, 42, 74–76, 81–84, 90–92, 263–295; map 4

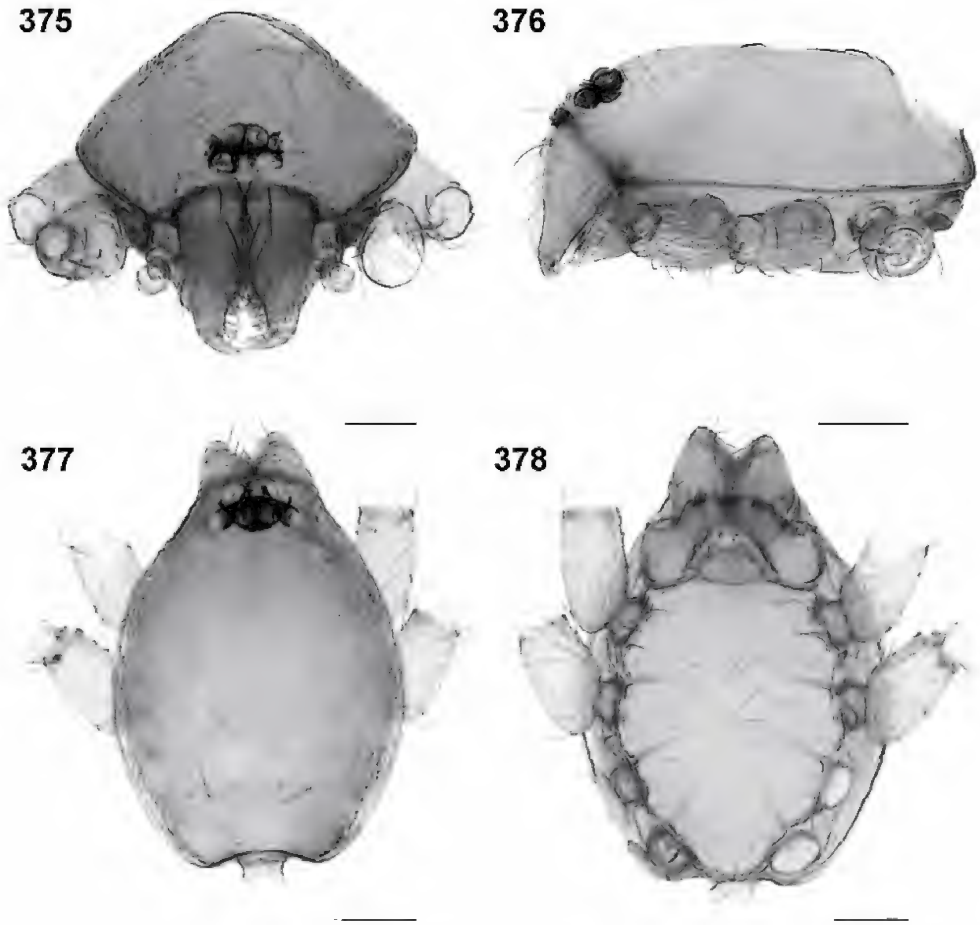
TYPES: Male holotype and female allotype from Mahajanga: Park National Tsingy de Bemaraha, 10.6 km ESE 123° E Antsalova, 19°42′34″S, 44°43′5″E, 150 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 16–20 November 2001, coll. B.L. Fisher et al. (CASC PBI_OON 35038).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. antsalova* resemble those of *O. ankarafantsika* and *O. andranomay* in having an elongated cymbiobulbus and those of *O. Ankarana* in having a tip more or less round, but can be differentiated from other *Opopaea* species by having it very thick and sclerotized on prolateral side (figs. 263–264, 304–305, 308–309, 312–320). Females of *O. antsalova* can be easily recognized by the V-shaped postgynum depression, very short and narrow, close to the epigastric furrow and with a more or less



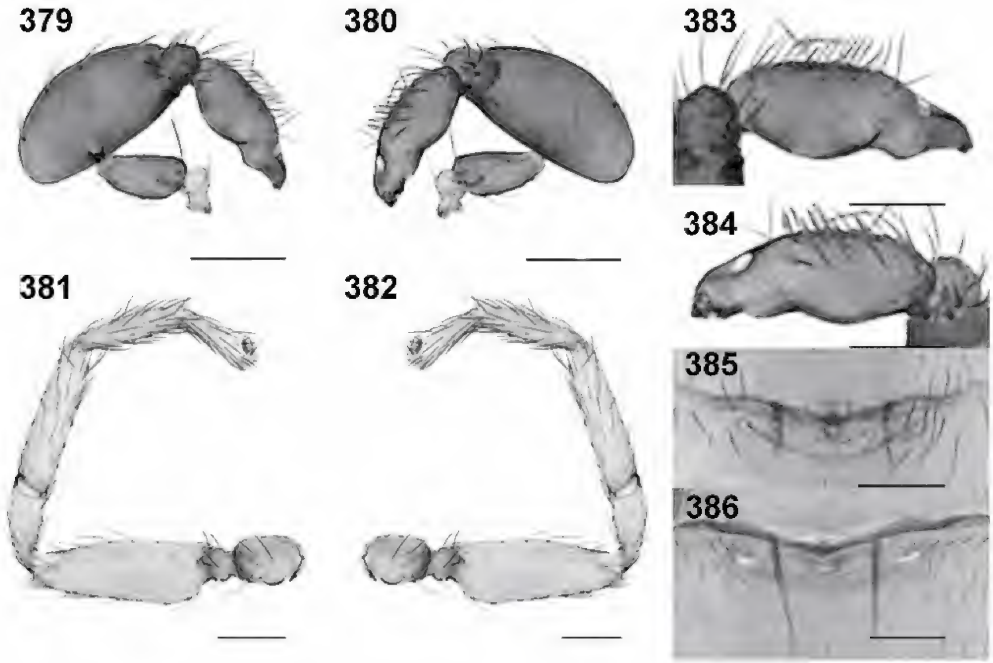
Figs. 366–374. *Opopaea bemarivo,* n. sp. **366.** Female, habitus, dorsal view. **367.** Habitus, ventral view. **368.** Abdomen, ventral view. **369.** Male, habitus, dorsal view. **370.** Habitus, ventral view. **371.** Abdomen, ventral view. **372.** Habitus, lateral view. **373.** Abdomen, lateral view. **374.** Abdomen, anterior view. Scale bars: 0.2 mm.



Figs. 375–378. *Opopaea bemarivo,* n. sp., female. **375.** Carapace, anterior view. **376.** Lateral view. **377.** Dorsal view. **378.** Ventral view. Scale bars: 0.2 mm.

thin and sclerotized ridge (figs. 265, 285–286).

DESCRIPTION: Male (holotype) (PBI_OON 35038). Large species. Total length 1.92. Color: orange. Carapace: pars cephalica not elevated posteriorly, with one row of two close sets of two denticles and a hair, carapace anteriorly narrowed to about one third its maximum width (figs. 276–277). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes large and almost of the same size, ALE largest. ALE more or less circular, PME squared and PLE oval; PME darkened compared to other eyes; posterior eye row straight viewed from above, slightly procurved from front; ALE separated by almost their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae; surface smooth and shiny, without pits, shape of posterior part between coxae IV wider proximally, but thin and constricted distally (fig. 278). Lateral margins of area between coxae III unmodified, without lumps; setae sparse, dark, needlelike, densest laterally, originating from surface, without hair tufts (figs. 275–278). Abdomen oval not flattened laterally toward posterior end. Palp posterior margin straight, with two barely visible protuberances: one small and wide proximally, small and the other more or less sharp distally (fig. 283). Palpal femora half the size of palpal patella and inserted medially



Figs. 379–386. *Opopaea bemarivo,* n. sp. **379.** Male, palp, prolateral view. **380.** Retrolateral view. **381.** Leg IV, prolateral view. **382.** Leg IV, retrolateral view. **383.** Male, palp, close up prolateral view. **384.** Retrolateral view. **385.** Epigynum, ventral view. **386.** Dorsal view. Scale bars: figures 381, 382 = 0.2 mm; others = 0.1 mm.

to it. Palpal fenestra large, elongated and enlarged anteriorly, located near the tip of the palp, fenestra top rose toward the tip (figs. 263–264, 279–280, 283–284, 287–295).

Female (allotype) (PBI_OON 35038). Total length 2.38. As in male but larger, color orange, abdomen oval, and not flattened posteriorly. Epigynum scutal ridge more or less thick and straight bearing a round medium-sized parmula within its median part (figs. 265, 285–286).

MEASUREMENTS: Male (holotype) (PBI_OON 35038). TL: 1.92; CL: 0.82; CW: 0.69; CH: 0.40; AL: 1.12; AW: 0.75; ALE: 0.12; PME: 0.11; PLE: 0.08; EGW: 0.26; ALE-ALE: 0.04; ALE-PLE: 0; PME-PME: 0; PLE-PME: 0; CBL: 0.28; CBW: 0.1; CBL/PTL: 0.87; FI: 0.16.

Female (allotype) (PBI_OON 35038). TL: 2.38; CL: 1; CW: 0.77; CH: 0.41; AL: 1.48; AW: 1; ALE: 0.11; PME: 0.11; PLE: 0.10; EGW: 0.27; ALE-ALE: 0.04; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; EFL: 0.24; LAL: 0.11; PGI (LAL/EFL): 0.46; PDL/LAL: 0.45; PDW/EFL: 0.29.

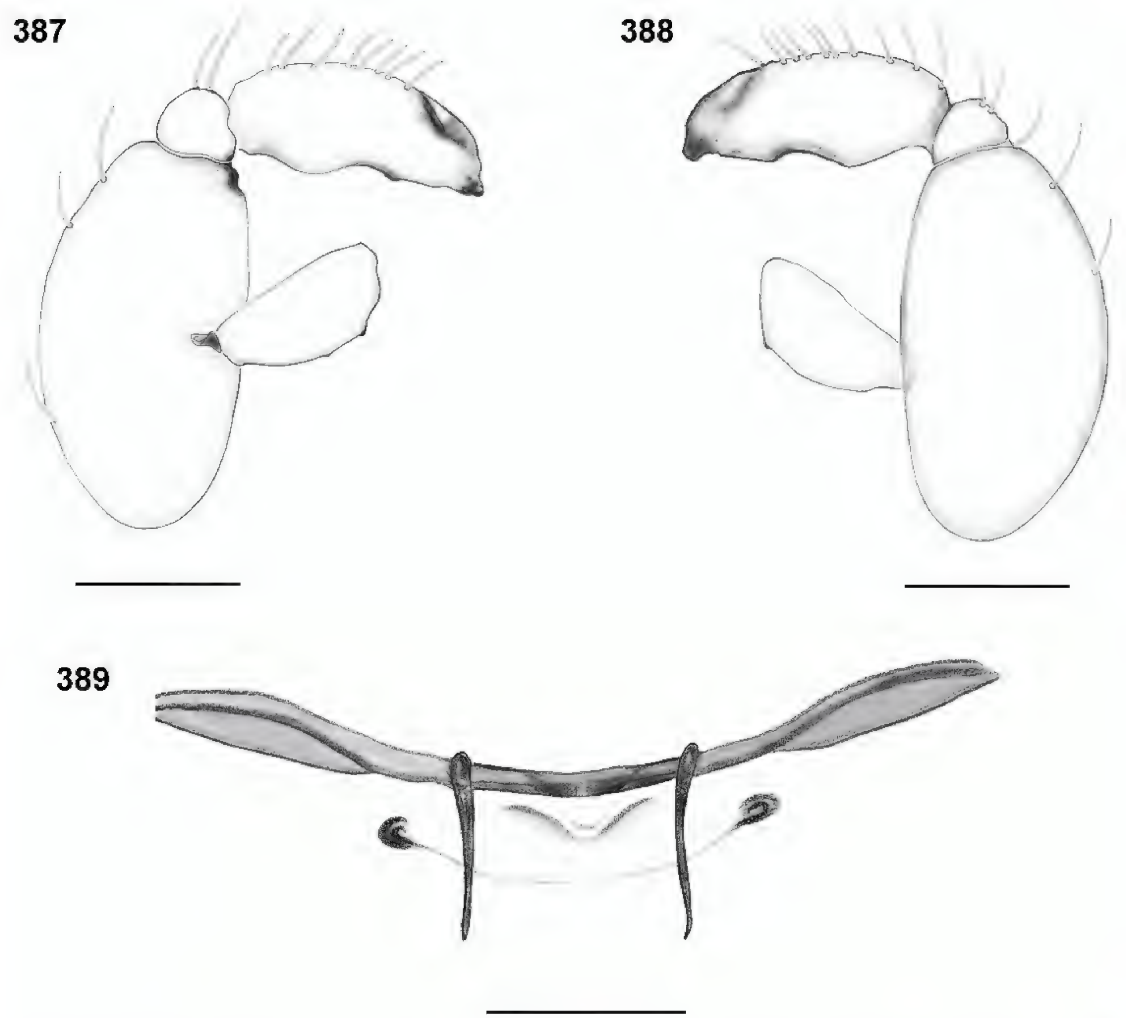
VARIATION: Male: TL: 1.92–2.03; CL: 0.82–0.91; CW: 0.69–0.71; AL: 1.12–1.18; AW: 0.75–0.76.

Female: TL: 2.38–2.43; CL: 0.97–1; CW: 0.75–0.77; AL: 1.46–1.52; AW: 0.96–1.

NATURAL HISTORY: *O. antsalova* was mostly found in tropical dry forest and spiny/thicket forest at low elevations (30–150 m).

DISTRIBUTION: *O. antsalova* was mostly found in the northwestern and southern regions of Madagascar in the provinces of Mahajanga and Toliara (Tsingy de Bemaraha, Ranobe) (map 4).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Mahajanga:** Park National Tsingy de Bemaraha, 3.4 km 93° E Bekopaka, Tombeau Vazimba, 19°8′31″S, 44°49′41″E, 50 m, general collecting, tropical dry forest, 06–10 November 2001, coll. B.L. Fisher et al. (CASC PBI_OON 35037), 1♀. **Mahajanga:** Park National Tsingy de Bemaraha, 10.6 km ESE 123° E Antsalova, 19°42′34″S, 44°43′5″E, 150 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 16–20



Figs. 387–389. *Opopaea berenty,* n. sp. **387.** Male, palp prolateral view. **388.** Retrolateral. **389.** Epigynum, dorsal view. Scale bars: 0.1 mm.

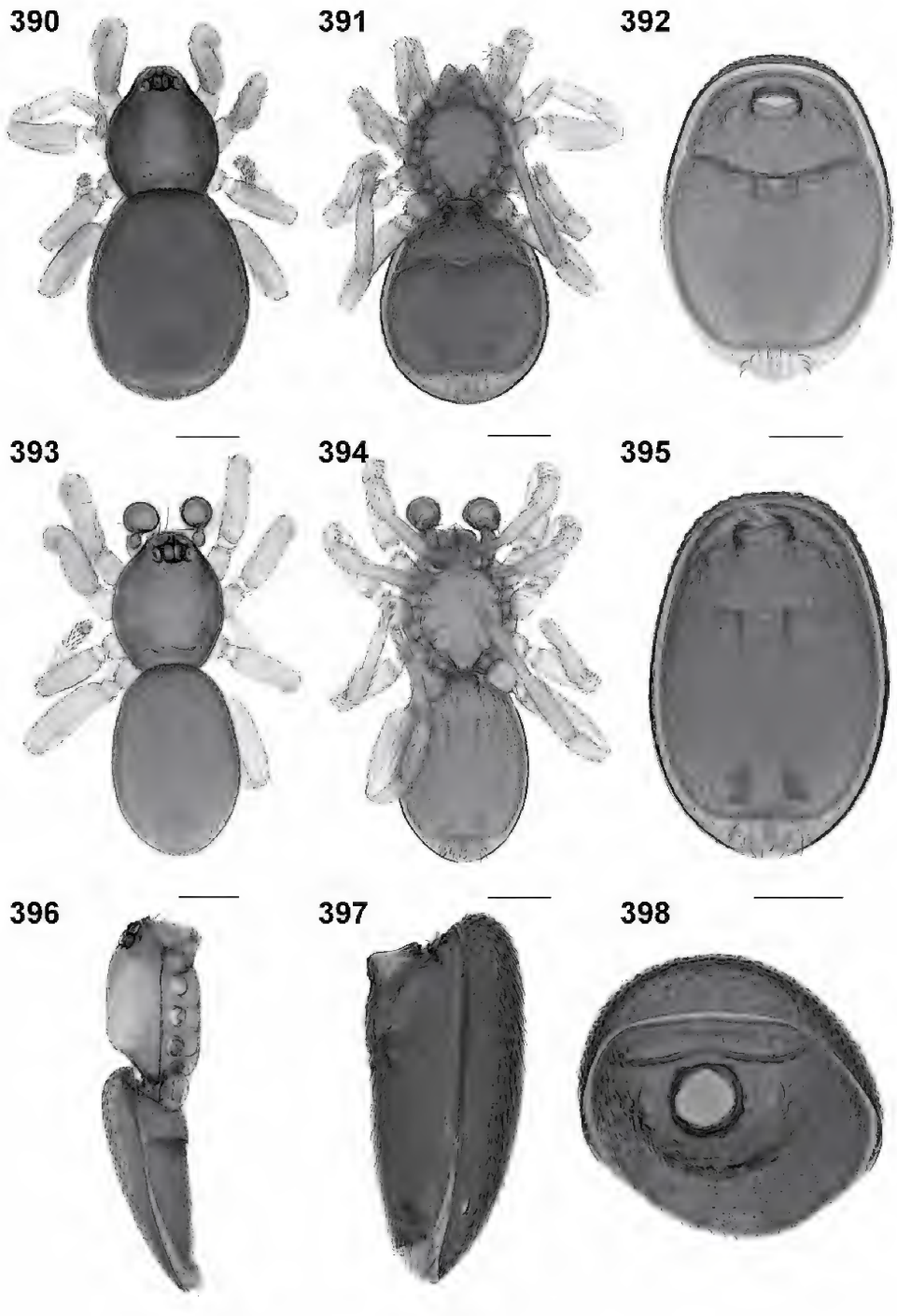
November 2001, coll. B.L. Fisher et al. (CASC PBI_OON 350380), 27♂, 21♀. **Toliara:** Ranobe, 23°02′23″S, 43°36′39″E, 30 m, EH11 sifted litter (leaf mold, rotten wood), spiny forest/thicket, 17–21 February 2003, coll. Frontier Project, MGF061 (CASC PBI_OON 3773), 1♀.

Opopaea antsiranana, new species
Figures 13, 15, 18, 29, 296–329; map 4

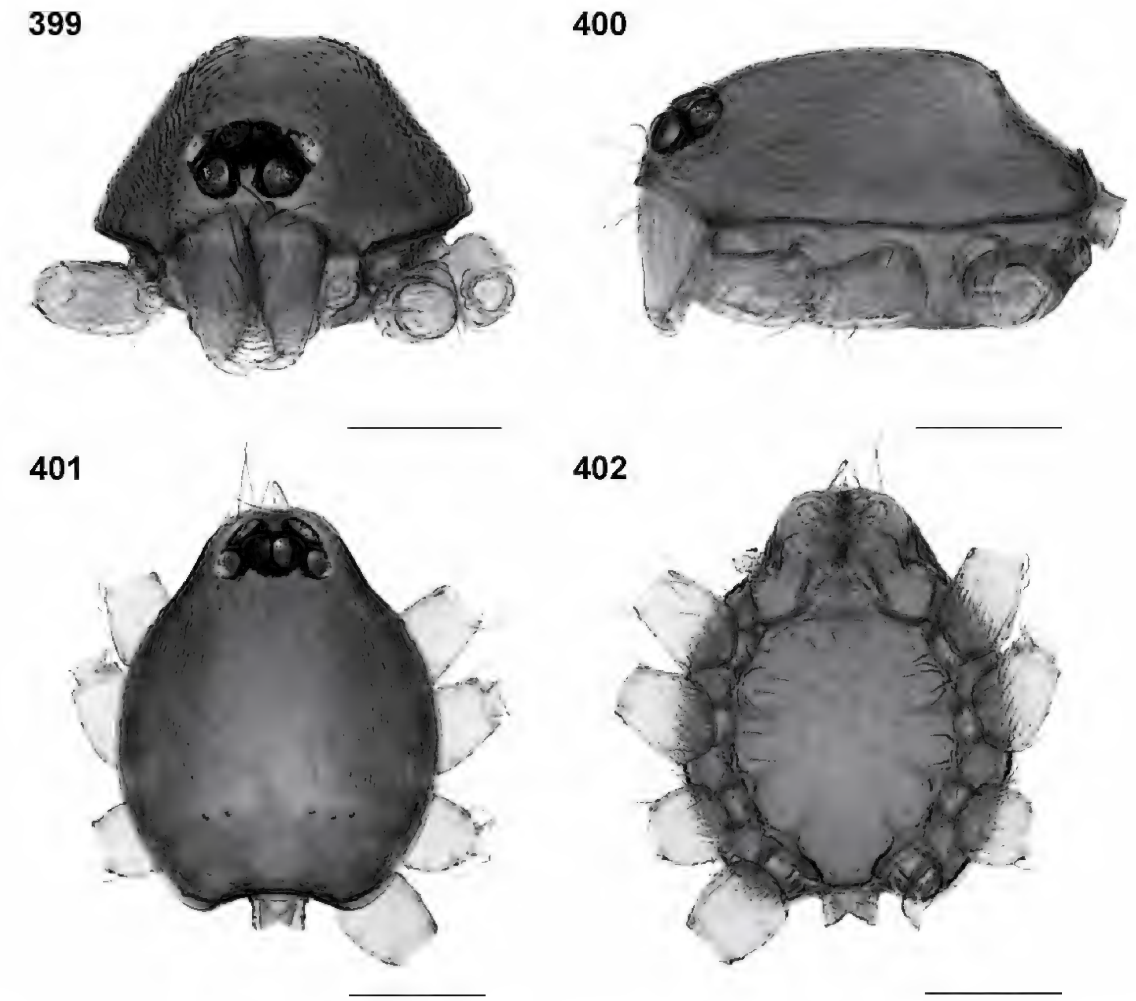
TYPES: Male holotype and female allotype from Antsiranana: Montagne des Français, 7.2 km 142° SE Antsiranana (Diego-Suarez), 12°19′22″S, 49°20′17″E, 180 m, EF19 sifted litter, tropical dry forest, 22–28 February 2001, coll. Fisher and Griswold et al., BLF3128 (CASC PBI_OON 3657).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. antsiranana* resemble those of *O. berenty* in having the cymbiobulbus slightly shorter than the patella (figs. 312–313, 403–404), but can be most easily distinguished from those of other *Opopaea* species in having the cymbiobulbus with one smooth and wide posteroproximal protuberance and palp tip conical, short, sclerotized, and pointing downward (fig. 317). Females of *O. antsiranana* can be distinguished by having



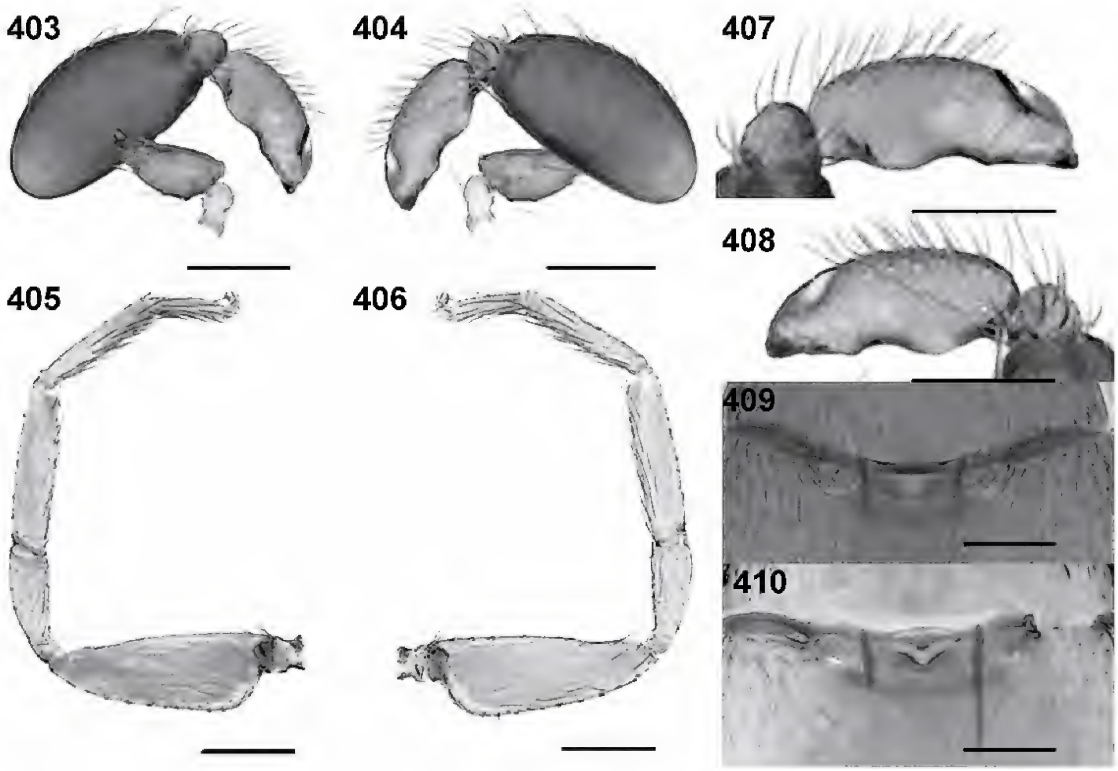
Figs. 390–398. *Opopaea berenty,* n. sp. **390.** Female, habitus, dorsal view. **391.** Habitus, ventral view. **392.** Abdomen, ventral view. **393.** Male, habitus, dorsal view. **394.** Habitus, ventral view. **395.** Abdomen, ventral view. **396.** Habitus, lateral view. **397.** Abdomen, lateral view. **398.** Abdomen, anterior view. Scale bars: 0.2 mm.



Figs. 399–402. *Opopaea berenty,* n. sp., female. **399.** Carapace, anterior view. **400.** Lateral view. **401.** Dorsal view. **402.** Ventral view. Scale bars: 0.2 mm.

a thick, sclerotized, and divided scutal ridge, bearing medially and within a round parmula (figs. 298, 318–319).

DESCRIPTION: Male (holotype) (PBI_OON 3657). Small to medium-sized species. Total length 1.47. Color: orange to yellowish orange. Carapace: pars cephalica elevated posteriorly with one row of two sets of four denticles (figs. 309, 310), carapace anteriorly narrowed to about one third its maximum width. Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes very large. ALE largest. ALE oval, PME and PLE circular, PME darkened compared to other eyes, posterior eye row straight viewed from above, procurved from front, ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae; surface smooth, without pits, shape of posterior part between coxae IV hexagonal (fig. 311). Lateral margins of area between coxae III unmodified, without lumps, setae sparse, dark, needlelike, and densest laterally, originating from surface, without hair tufts (figs. 308–311). Palp fenestra very large, more or less circular, enlarged anteriorly, located near the tip. Fenestra on top, flat, but



Figs. 403–410. *Opopaea berenty,* n. sp. **403.** Male, palp, prolateral view. **404.** Retrolateral view. **405.** Leg IV, prolateral view. **406.** Retrolateral view. **407.** Male, palp, close up, prolateral view. **408.** Retrolateral view. **409.** Epigynum, ventral view. **410.** Dorsal view. Scale bars: figures 405, 406 = 0.2 mm; others = 0.1 mm.

rises slightly anteriorly. Palpal femora shorter, inserted at about one half the length of patella (figs. 296–297, 312–313, 316–317, 320–329).

Female (allotype) (PBI_OON 3657). Total length 1.77. Orange, abdomen more or less round, and more or less flattened posteriorly, opercula small and not darkened. Postgynum depression extremely short and narrow, ridge thin and not sclerotized (figs. 298, 318–319).

MEASUREMENTS: Male (holotype) (PBI_OON 3657). TL: 1.47; CL: 0.65; CW: 0.56; CH: 0.28; AL: 0.89; AW: 0.64; ALE: 0.09; PME: 0.09; PLE: 0.08; EGW: 0.22; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; CBL: 0.21; CBW: 0.08; CBL/PTL: 0.72; FI: 0.13.

Female (allotype) (PBI_OON 3657). TL: 1.77; CL: 0.71; CW: 0.59; CH: 0.31; AL: 1.14; AW: 0.86; ALE: 0.09; PME: 0.08; PLE: 0.08; EGW: 0.22; ALE-ALE: 0.04; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.01; EFL: 0.19; LAL: 0.08; PGI (LAL/EFL): 0.42; PDL/LAL: 0.50; PDW/EFL: 0.37.

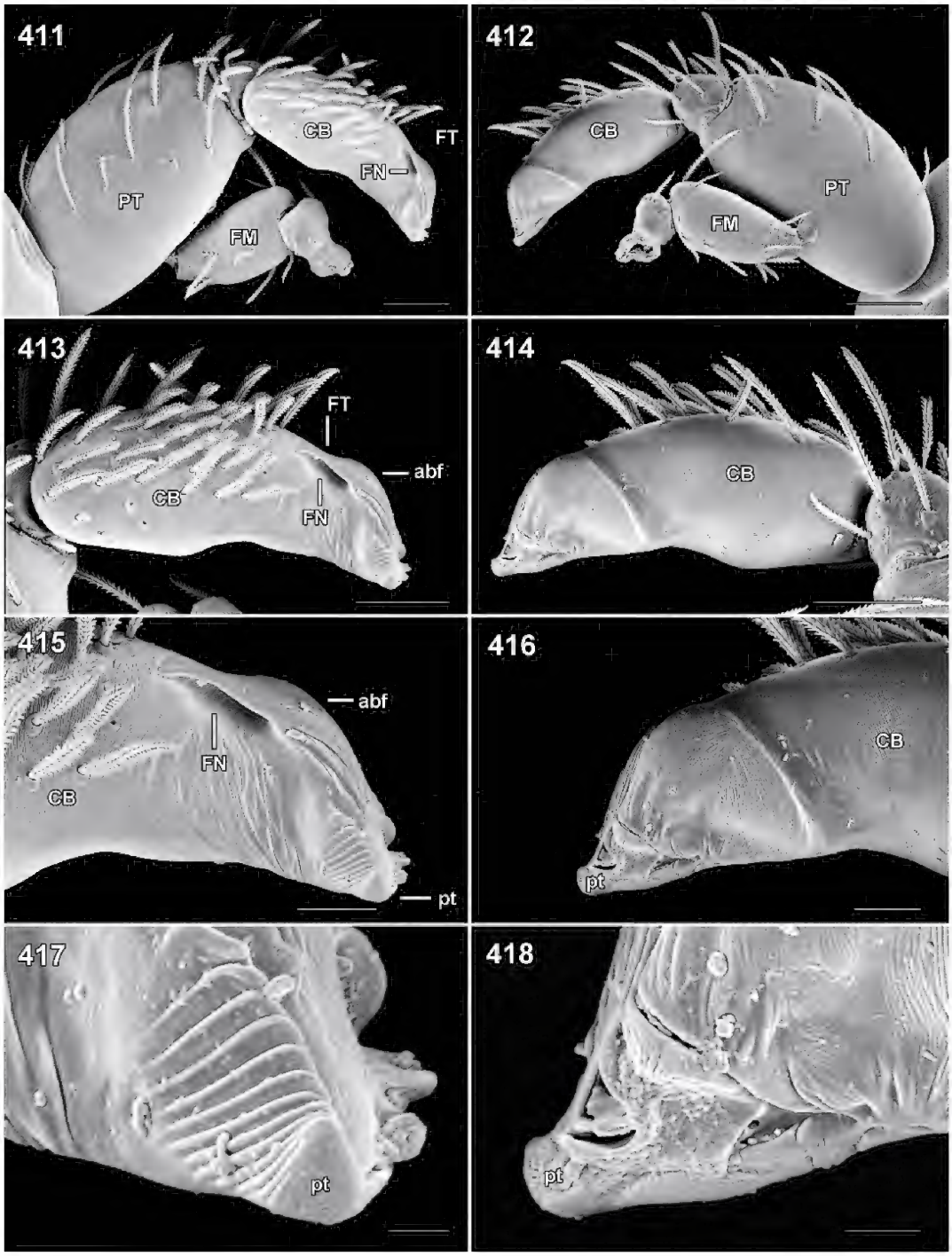
VARIATION: Male: TL: 1.47–1.49; CL: 0.65–0.67; CW: 0.55–0.56; AL: 0.89–0.95; AW: 0.64–0.67.

Female: TL: 1.65–1.78; CL: 0.70–0.72; CW: 0.58–0.60; AL: 1.04–1.14; AW: 0.79–0.86.

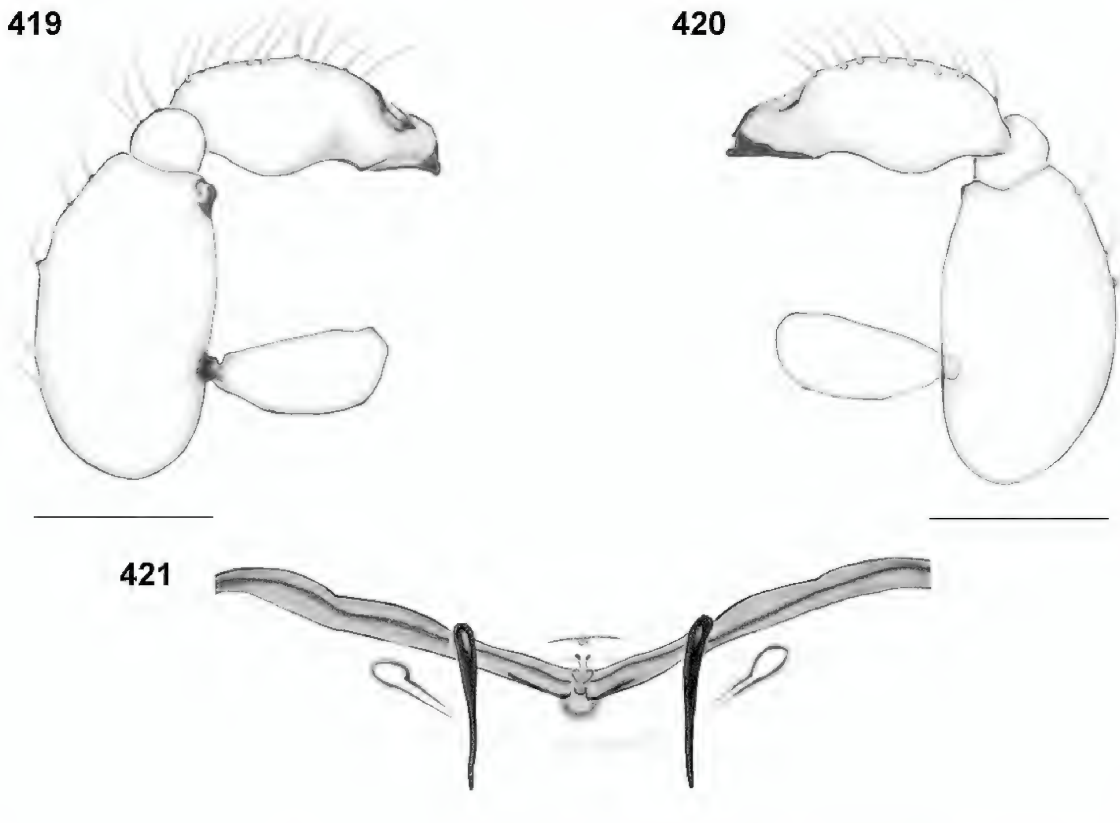
NATURAL HISTORY: *O. antsiranana* was mostly found in tropical dry forest at low elevations (180 m).

DISTRIBUTION: *O. antsiranana* was mostly found in the north of Madagascar in the province of Antsiranana (Montagne des Français) (map 4).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Antsiranana:** Montagne des Français, 7.2 km 142° SE Antsiranana (Diego-Suarez), 12°19′22″S, 49°20′17″E, 180 m, EF19 sifted litter, tropical dry forest, 22–28



Figs. 411–418. *Opopaea berenty,* n. sp., male palp. **411.** Prolateral view. **412.** Retrolateral view. **413, 415.** Close up, prolateral view. **414, 416.** Close up, retrolateral view. **417.** Embolar region, prolateral view. **418.** Retrolateral view. Scale bars: figures 411–412 = 40 μm; figures 413–414 = 30 μm; figures 415–416 = 15 μm; figures 417–418 = 4 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.



Figs. 419–421. *Opopaea betioky,* n. sp. **419.** Male, palp prolateral view. **420.** Retrolateral view. **421.** Epigynum, dorsal view. Scale bars: 0.1 mm.

February 2001, coll. Fisher and Griswold et al., BLF3128 (CASC PBI_OON 3687), 1♂, 1♀ (CASC PBI_OON 3657), 9♂, 19♀.

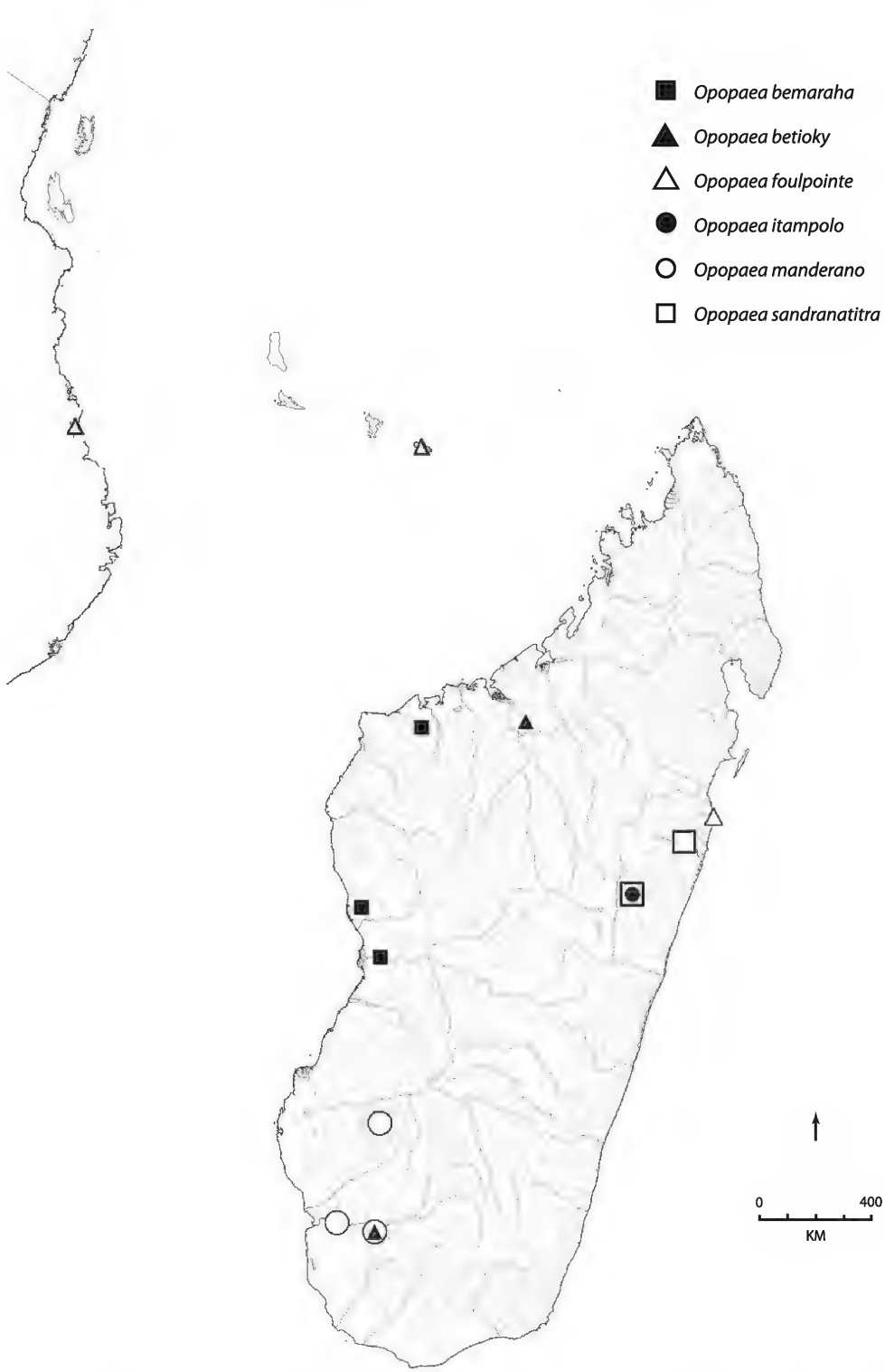
Opopaea bemaraha, new species
Figures 330–362; map 3

TYPES: Male holotype and female allotype from Mahajanga: PN Tsingy de Bemaraha, 10.6 km 123° ESE Antsalova, Ankidrodroa River, 19°42′34″S, 44°43′5″E, 150 m elevation, 16–20 November 2001, tropical dry forest on Tsingy, EF19 sifted litter (leaf mold, rotten wood), coll. B.L. Fisher et al., BLF4432 (CASC PBI_OON 35139).

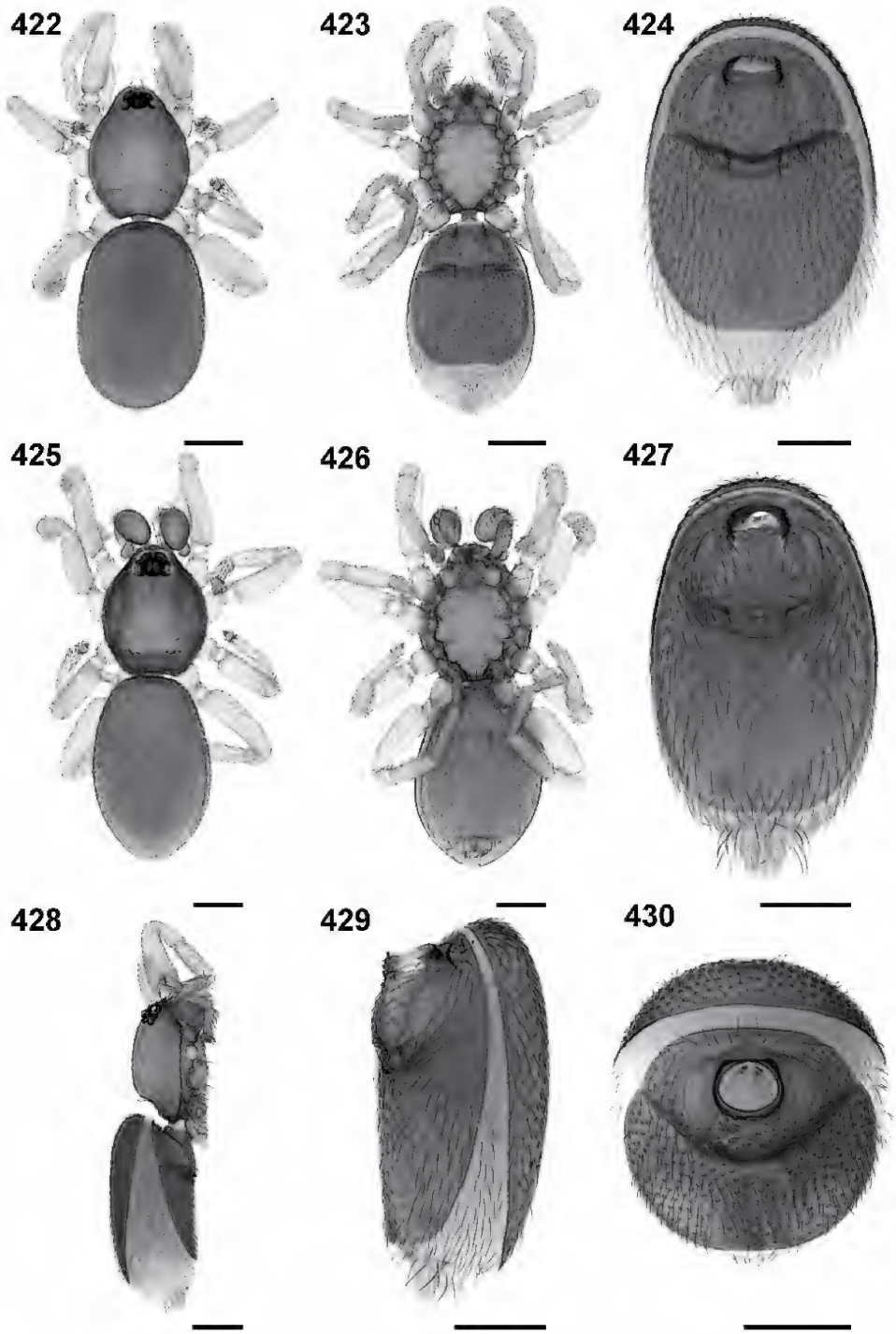
ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. bemaraha* resemble those of *O. tsimbazaza* in having the area in front of the fenestra quite developed (figs. 360, 842), but can be most easily distinguished from those of other *Opopaea* species by having the area between the two posterior protuberances arclike and sharp like a blade and the tip of the cymbiobulbus tapering anteriorly, ending with a small hole (figs. 346, 350) that is surrounded posteriorly by a short sclerotized lip directed on one side (figs. 360, 361) and not downward like in *O. tsimbazaza* (figs. 844, 847). Females of *O. bemaraha* can be recognized by a scutal ridge divided into an arclike upper part covering a thicker, more sclerotized lower part, which bears medially a cylindrical parmula. Posterior margin of scutal ridge bears a small and short sclerotized round nudge at the level of the parmula (figs. 332, 352–353).

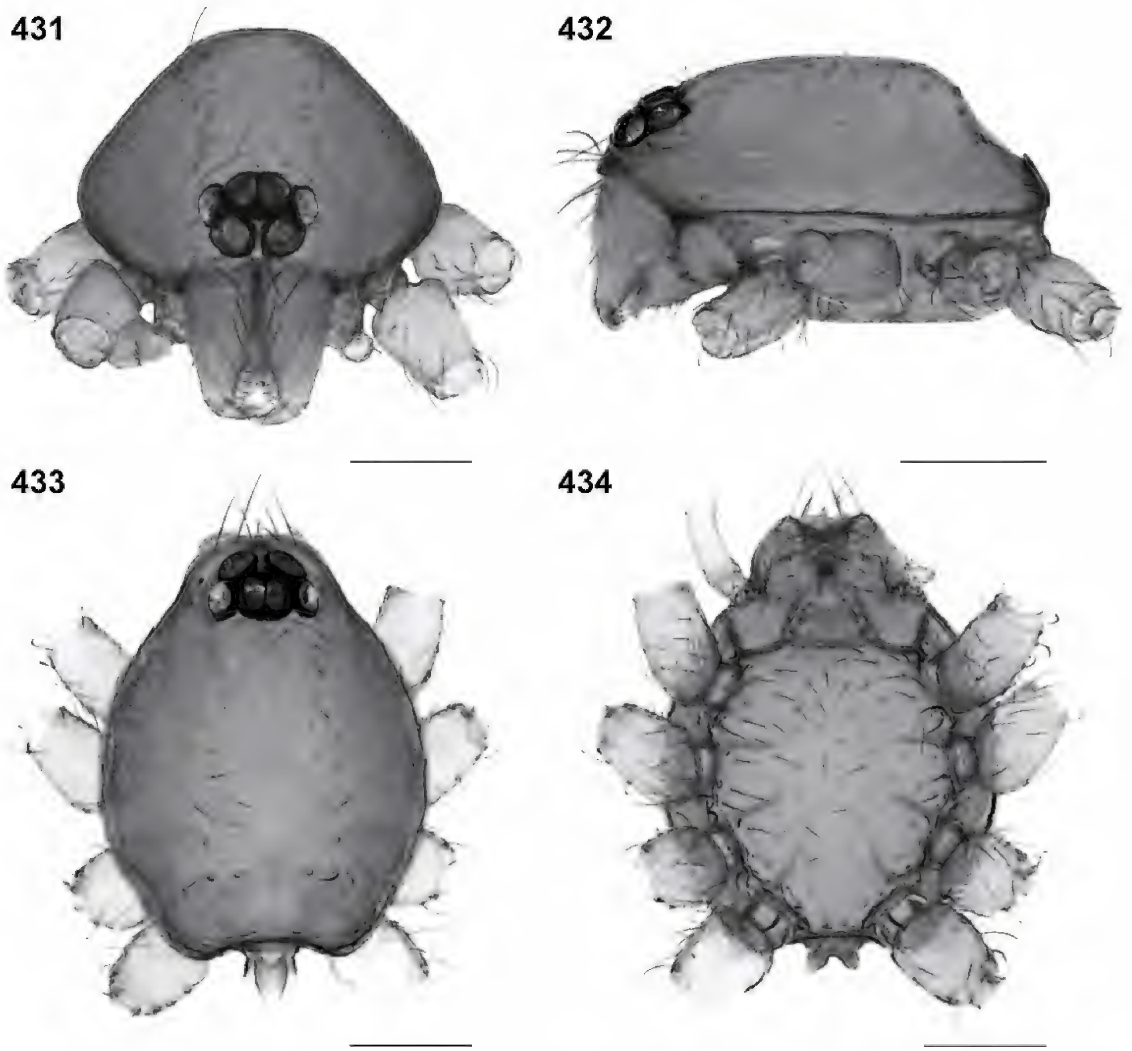
DESCRIPTION: Male (holotype) (PBI_OON 35139). Small to medium-sized species. Total length 1.29. Color: orange. Carapace: pars cephalica elevated posteriorly into a dome with two widely separated sets of two



Map 3. Specimen records of *Opopaea* species in Madagascar: *O. bemaraha, betioky, foulpointe, itampolo, manderano,* and *sandranantitra.*

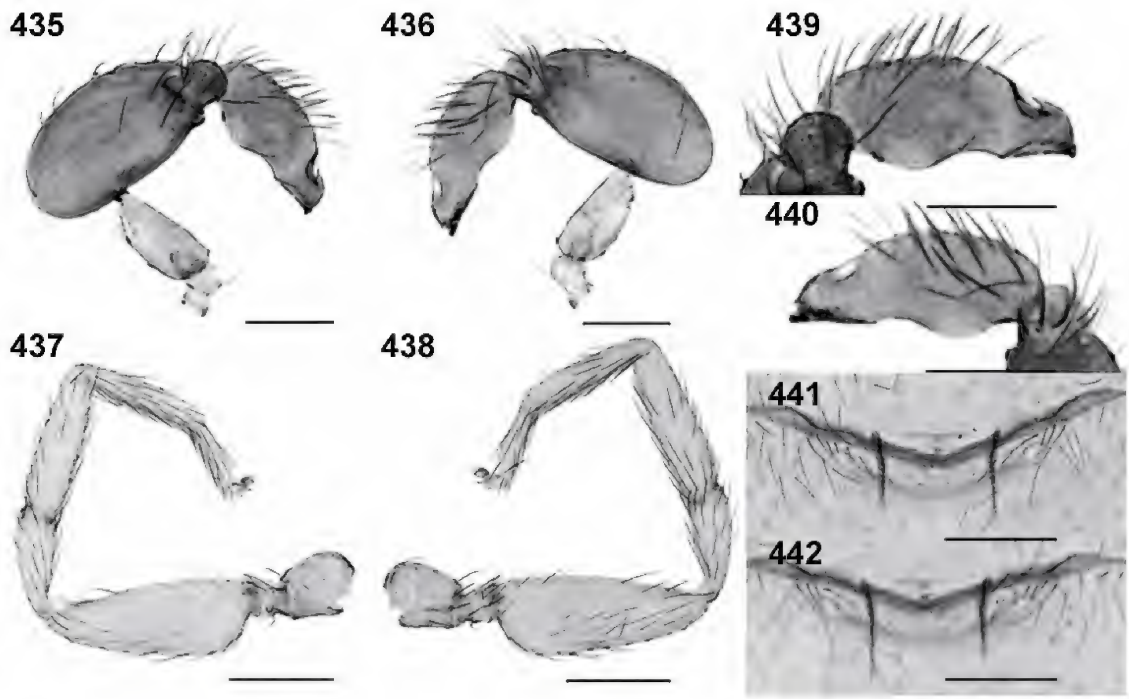


Figs. 422–430. *Opopaea betioky,* n. sp. **422.** Female, habitus, dorsal view. **423.** Habitus, ventral view. **424.** Abdomen, ventral view. **425.** Male, habitus, dorsal view. **426.** Habitus, ventral view. **427.** Abdomen, ventral view. **428.** Habitus, lateral view. **429.** Abdomen, lateral view. **430.** Anterior view. Scale bars: 0.2 mm.



Figs. 431–434. *Opopaea betioky,* n. sp. **431.** Carapace, anterior view. **432.** Lateral view. **433.** Dorsal view. **434.** Ventral view. Scale bars: 0.2 mm.

small denticles (figs. 343–345). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes small. ALE largest. ALE, PME oval, PLE circular; posterior eye row straight viewed from above, slightly procurved from front; ALE separated by their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth and shiny, without pits, shape of posterior part hexagonal between coxae IV not constricted (fig. 345). Lateral margins of area between coxae III unmodified, without lumps, setae sparse, more abundant and on margins, originating from surface, without hair tufts. Palp with three posterior protuberances: one larger and smoother on proximal margin, one smaller and very sharp on distal margin and a small one on retrolateral margin. Palpal femora half the size of palpal patella and inserted at one third of patella length. Palpal fenestra large, elongated, enlarged posteriorly and located at one third the length of the palp, fenestra barely raised and sclerotized anteriorly (figs. 115–116, 365–366, 369–370, 373–381).



Figs. 435–442. *Opopaea betioky,* n. sp. **435.** Male, palp, prolateral view. **436.** Retrolateral view. **437.** Leg IV, prolateral view. **438.** Retrolateral view. **439.** Male, palp, close up, prolateral view. **440.** Retrolateral view. **441.** Epigynum, ventral view. **442.** Dorsal view. Scale bars: figures 437, 438 = 0.2 mm; others = 0.1 mm.

Female (allotype) (PBI_OON 35139). Total length 1.58. As in male but larger, color orange, abdomen oval and not flattened posteriorly. Postgynum depression short and narrow, ridge more or less thin and weakly sclerotized (figs. 332, 352–353).

MEASUREMENTS: Male (holotype) (PBI_OON 35139). TL: 1.29; CL: 0.60; CW: 0.50; CH: 0.29; AL: 0.73; AW: 0.52; ALE: 0.08; PME: 0.09; PLE: 0.08; EGW: 0.22; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.01; CBL: 0.21; CBW: 0.07; CBL/PTL: 0.84; FI: 0.11.

Female (allotype) (PBI_OON 35139). TL: 1.58; CL: 0.70; CW: 0.54; CH: 0.26; AL: 0.93; AW: 0.71; ALE: 0.08; PME: 0.06; PLE: 0.05; EGW: 0.17; ALE-ALE: 0.03; ALE-PLE: 0; PME-PME: 0; PLE-PME: 0; EFL: 0.16; LAL: 0.07; PGI (LAL/EFL): 0.44; PDL/LAL: 0.57; PDW/EFL: 0.49.

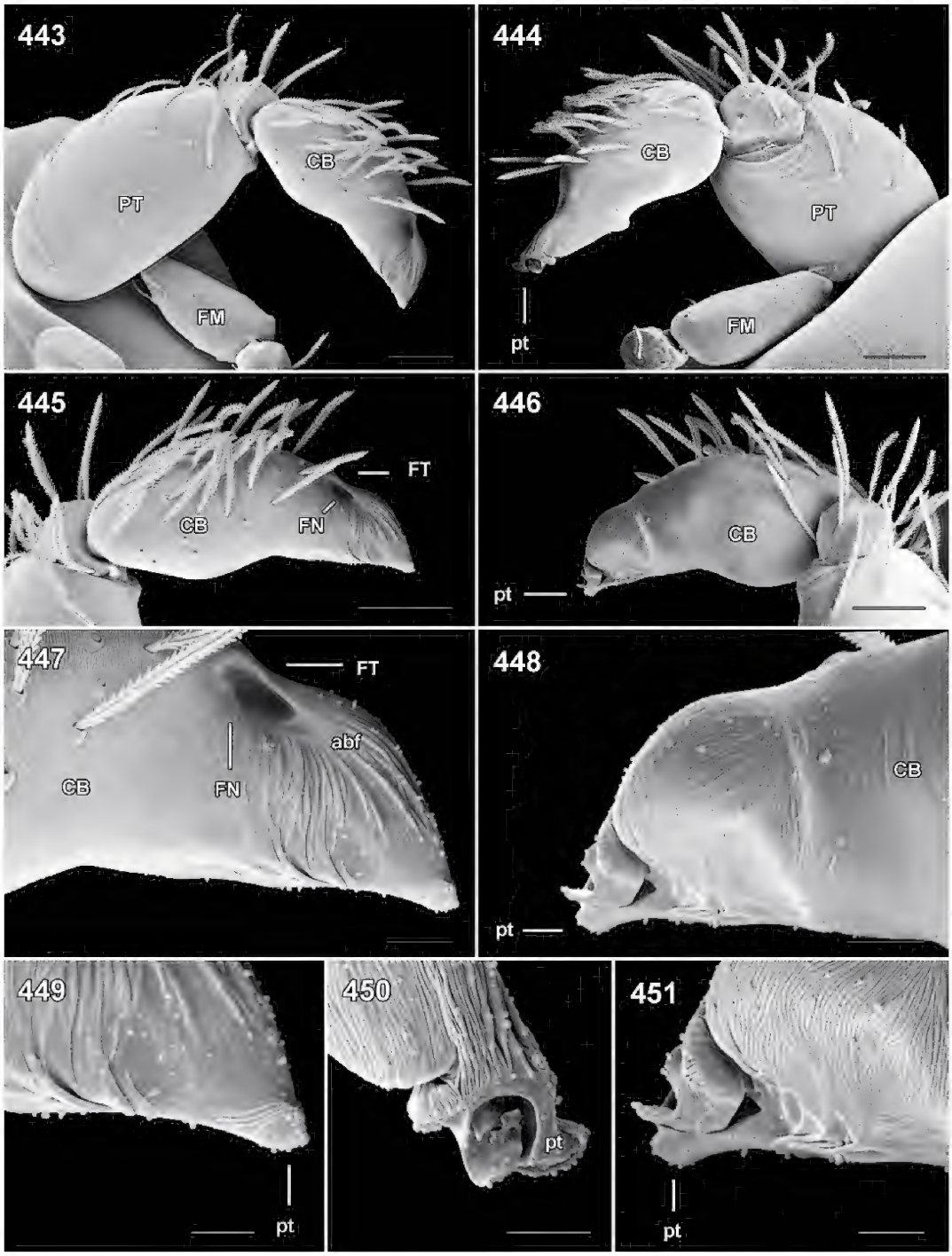
VARIATION: Male: TL: 1.29–1.39; CL: 0.60–0.61; CW: 0.49–0.50; AL: 0.73–0.79; AW: 0.52–0.61.

Female: TL: 1.58–1.58; CL: 0.66–0.70; CW: 0.54–0.54; AL: 0.92–0.93; AW: 0.66–0.71.

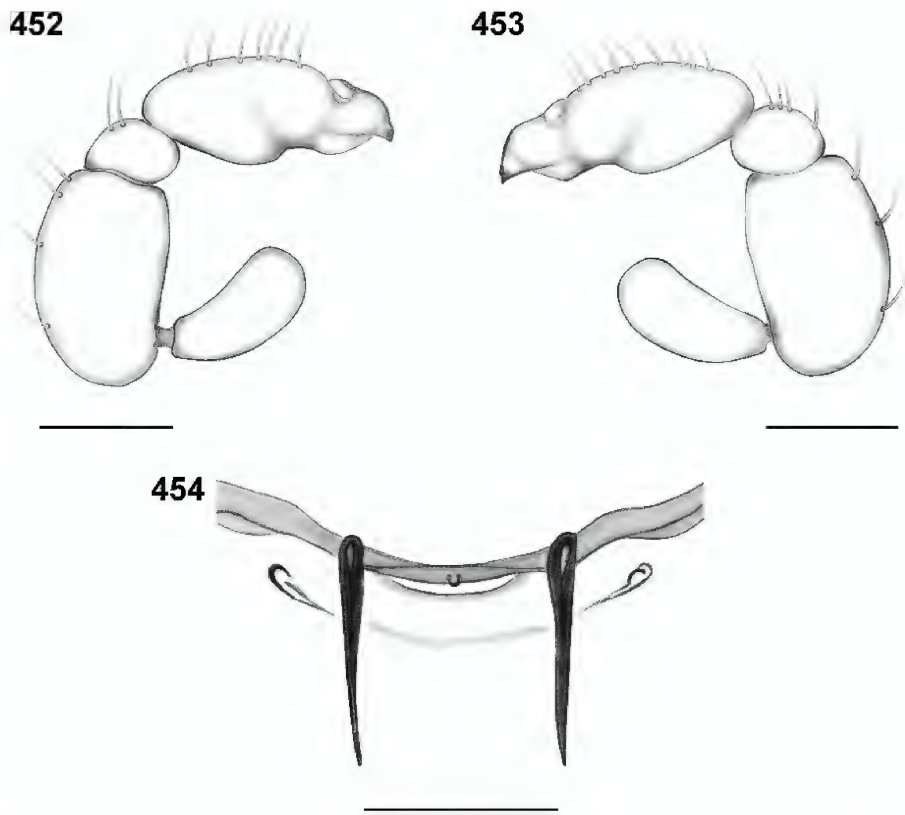
NATURAL HISTORY: *O. bemaraha* was mostly found in tropical dry forest at low elevations (50–150 m).

DISTRIBUTION: *O. bemaraha* was mostly found in the west of Madagascar in the province of Mahajanga (Tsingy de Bemaraha, Namoroka, Tsimembo) (map 3).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Mahajanga:** PN Tsingy de Bemaraha, 10.6 km 123° ESE Antsalova, Ankidrodroa River, S19°42′34″, E44°43′5″, 150 m elevation, 16–20 November 2001, tropical dry forest on Tsingy, EF19 sifted litter (leaf mold, rotten wood), coll. B.L. Fisher et al., BLF4432 (CASC PBI_OON 35139), 34♂, 29♀. Forêt de Tsimembo, 11 km 346° NNW Soatana, S18°59′43″, E44°26′37″, 50 m elevation, 21–25 November 2001, tropical dry forest, EF19 sifted litter (leaf mold, rotten wood), coll. B.L. Fisher et al.,



Figs. 443–451. *Opopaea betioky,* n. sp., male palp. **443.** Prolateral view. **444.** Retrolateral view. **445, 447.** Close up, prolateral view. **446, 448.** Retrolateral view. **449.** Embolar region, prolateral view. **450.** Anterior view. **451.** Retrolateral view. Scale bars: figures 443, 444 = 40 μm; figures 445, 446 = 20 μm; figures 447, 448 = 10 μm; figures 449–451 = 4 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.



Figs. 452–454. *Opopaea foulpointe,* n. sp. **452.** Male, palp, prolateral view. **453.** Retrolateral view. **454.** Epigynum, dorsal view. Scale bars: 0.1 mm.

BLF4508 (CASC PBI_OON 35126), 4♀. Parc National de Namoroka, 16.9 km 317° NW Vilanandro, S16°24′24″, E45°18′36″, 100 m elevation, 12–16 November 2002, tropical dry forest, EF19 sifted litter (leaf mold, rotten wood), C. Griswold and B.Fisher, et al., BLF6582 (CASC PBI_OON 3), 6♂, 2♀.

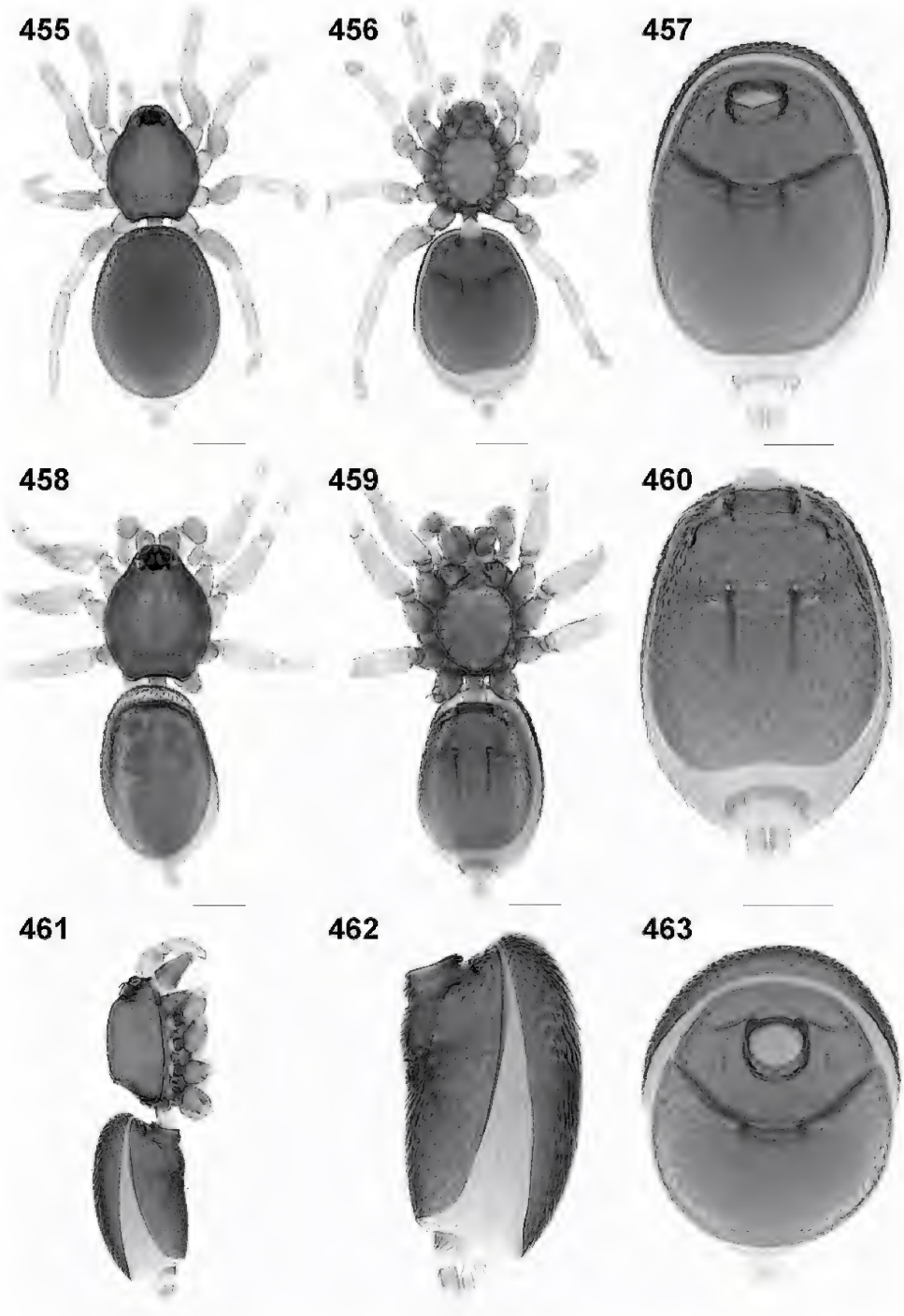
Opopaea bemarivo, new species
Figures 363–386; map 1

TYPES: Male holotype and female allotype from Mahajanga province: Réserve spéciale de Bemarivo, 23.8 km 223° SW Besalampy, 16°55′30″S, 44°22′06″E, 30 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 19–23 November 2002, coll. Fisher and Griswold et al., BLF6692 (CASC PBI_OON 3786).

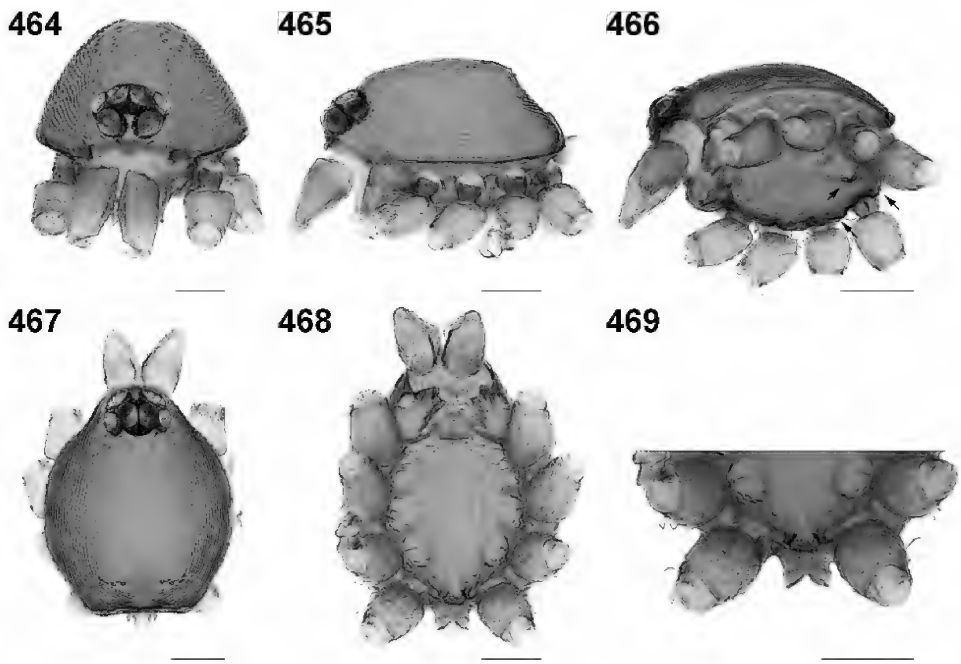
ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. bemarivo* resemble those of *O. kirindy* in having the anterior margin of the cymbiobulbus more or less tubular (figs. 379, 381 and 530, 531), but can be distinguished from those of other *Opopaea* species by having at the anterior margin of the cymbiobulbus a sclerotized line starting from the anterior margin of fenestra to the tip of the palp and curving downward toward a truncated tip (fig. 383) and by having the tip with two short, sclerotized lateral extensions directed toward the prolateral side. Females of *bemarivo* can be easily distinguished from other species by having the postgynum depression short, narrow, sclerotized, and U-shaped and the postgynum depression ridge thick and sclerotized (figs. 365, 385–386).

DESCRIPTION: Male (holotype) (PBI_OON 3786). Small species. Total length 1.15. Color: yellowish orange. Carapace: pars cephalica rather flat, not elevated posteriorly with one row of four denticles and two hairs



Figs. 455–463. *Opopaea foulpointe,* n. sp. **455.** Female, habitus, dorsal view. **456.** Habitus, ventral view. **457.** Abdomen, ventral view. **458.** Male, habitus, dorsal view. **459.** Habitus, ventral view. **460.** Abdomen, ventral view. **461.** Habitus, lateral view. **462.** Abdomen, lateral. **463.** Anterior view. Scale bars: 0.2 mm.



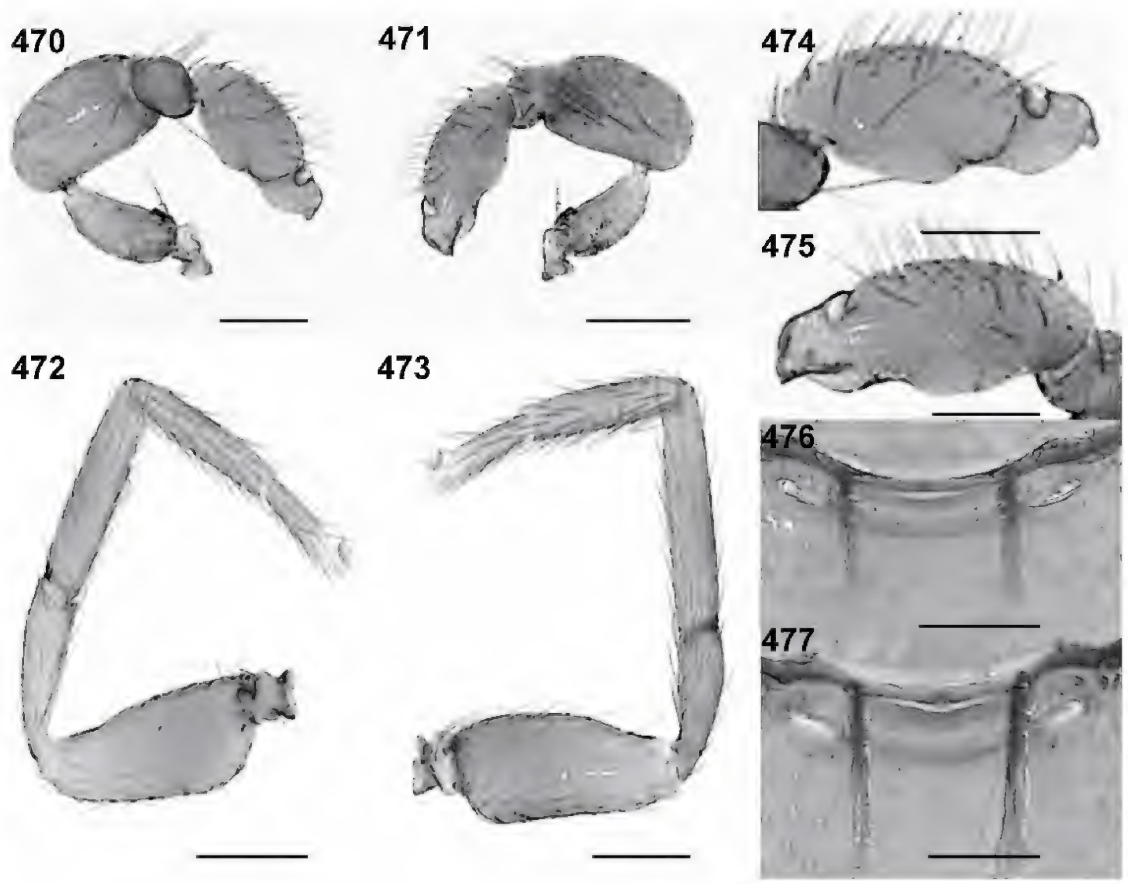
Figs. 464–469. *Opopaea foulpointe,* n. sp., male. **464.** Carapace, anterior view. **465.** Lateral view. **466.** Ventral view. **467.** Dorsal view. **468.** Ventral view. **469.** Sternum, posterior part, ventral view. Scale bars: 0.2 mm.

(figs. 375–377), carapace anteriorly narrowed to about one third its maximum width. Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes very small. ALE and PME largest. ALE oval, PME and PLE circular; PME darkened compared to other eyes; posterior eye row straight viewed from above, slightly procurved from front; ALE separated by their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae; surface smooth and shiny, without pits, shape of posterior part between coxae IV hexagonal (fig. 378). Area between coxae III unmodified, without lumps, setae sparse, dark, needlelike, densest medially and laterally, originating from surface, without hair tufts (figs. 375–378). Male palp posterior margin with two large, smooth posterior protuberances. Palpal fenestra small and round, located at one third the length of the palp, fenestral top thin, not raised as in *O. kirindy*. Area before fenestra sclerotized and more or less thick but not raised like a dome, becoming thinner toward the tip. Cymbiobulbus slightly shorter than patella. Palpal femur length about half the length of palpal patella (figs. 363–364, 379–380, 383–384).

Female (allotype) (PBI_OON 3786). Total length 1.32. Yellowish orange, abdomen oval to cylindrical, and not flattened posteriorly. Epigynum scutal ridge thin, weakly sclerotized, bearing a small round parmula on a thin sclerotized plate in its median part (figs. 365, 385–386).

MEASUREMENTS: Male (holotype) (PBI_OON 3786). TL: 1.15; CL: 0.54; CW: 0.40; CH: 0.21; AL: 0.64; AW: 0.37; ALE: 0.04; PME: 0.04; PLE: 0.03; EGW: 0.12; ALE-ALE: 0.02; ALE-PLE: 0; PME-PME: 0; PLE-PME: 0.01; CBL: 0.17; CBW: 0.07; CBL/PTL: 0.85; FI: 0.09.

Female (allotype) (PBI_OON 3786). TL: 1.32; CL: 0.59; CW: 0.42; CH: 0.21; AL: 0.80; AW: 0.46; ALE: 0.04; PME: 0.04; PLE: 0.03; EGW: 0.11; ALE-ALE: 0.02; ALE-PLE: 0; PME-PME: 0; PLE-PME: 0; EFL: 0.13; LAL: 0.05; PGI (LAL/EFL): 0.38; PDL/LAL: 0.60; PDW/EFL: 0.23.



Figs. 470–477. *Opopaea foulpointe,* n. sp. **470.** Male, palp, prolateral view. **471.** Retrolateral view. **472.** Leg IV, prolateral view. **473.** Retrolateral view. **474.** Male, palp, close up, prolateral view. **475.** Retrolateral view. **476.** Epigynum, ventral view. **477.** Dorsal view. Scale bars: figures 472, 473 = 0.2 mm; others = 0.1 mm.

VARIATION: Male: TL: 1.15–1.19; CL: 0.53–0.54; CW: 0.38–0.40; AL: 0.63–0.66; AW: 0.37–0.38.

Female: TL: 1.25–1.32; CL: 0.56–0.59; CW: 0.40–0.42; AL: 0.74–0.80; AW: 0.45–0.46.

NATURAL HISTORY: *O. bemarivo* was mostly found in tropical dry forest at low elevations (30 m).

DISTRIBUTION: *O. bemarivo* was found in southwestern Madagascar in the province of Mahajanga (Bemarivo) (map 1).

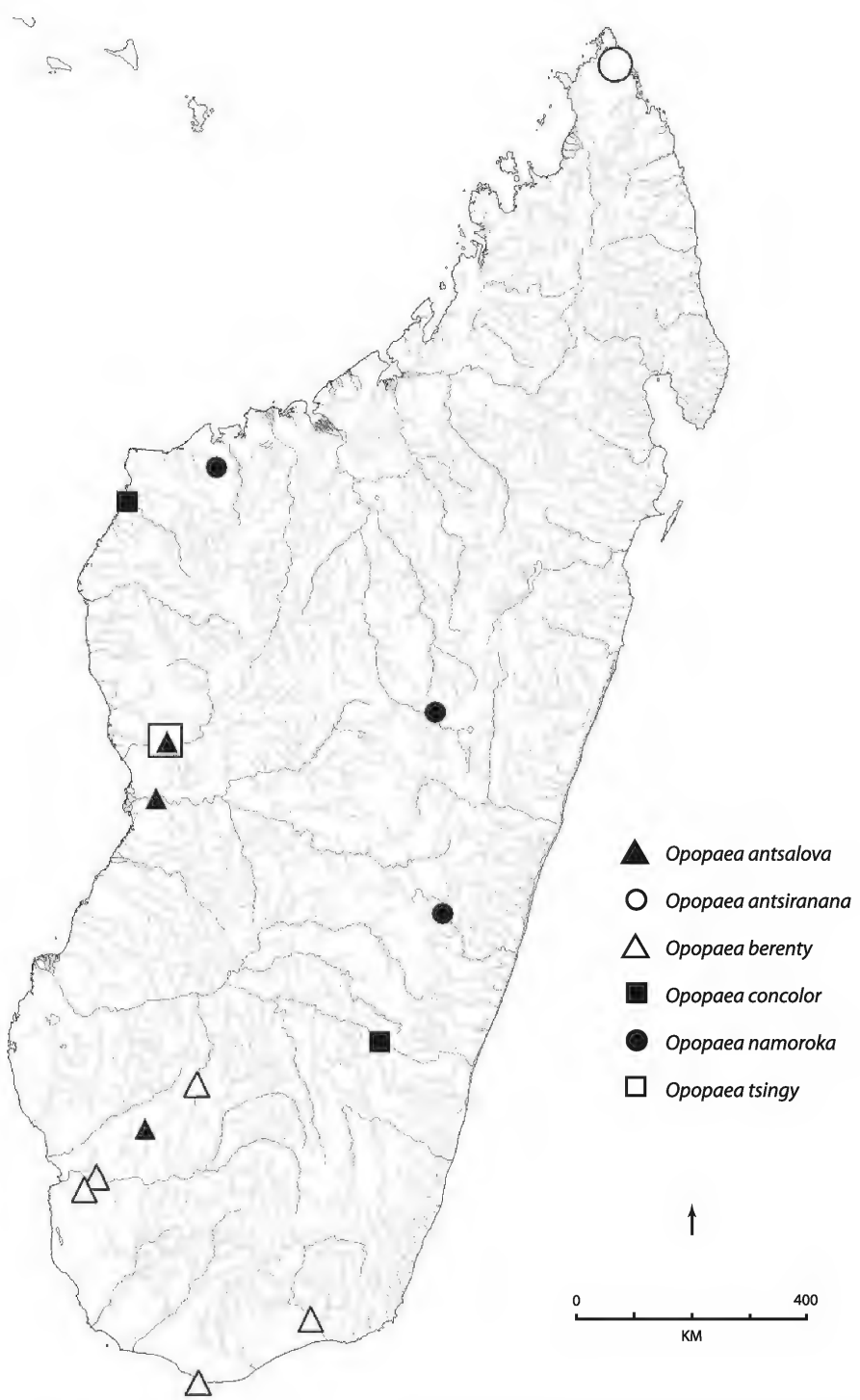
OTHER MATERIAL EXAMINED: MADAGASCAR: **Mahajanga:** Réserve spéciale de Bemarivo, 23.8 km 223° SW Besalampy, 16°55′30″S, 44°22′06″E, 30 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 19–23 November 2002, coll. Fisher and Griswold et al., BLF6692 (CASC PBI_OON 3786), 3♂, 3♀.

Opopaea berenty, new species
Figures 387–418; map 4

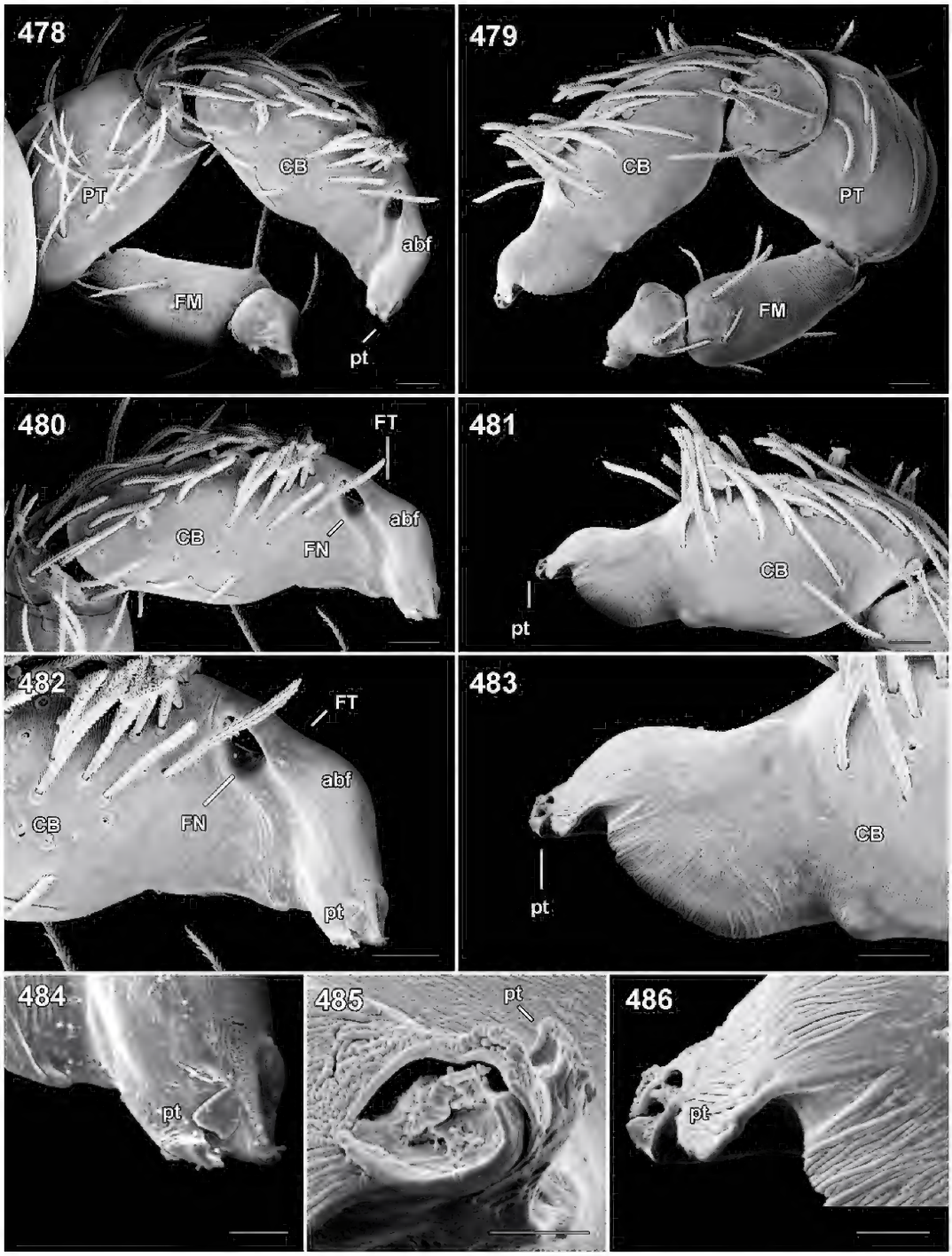
TYPES: Male holotype and female allotype from Toliara province: Réserve privée de Berenty, forêt de Bealoka, Mandraré river, 14.6 km 329° NNW Amboasary, gallery forest, 24°57′25″S, 46°16′17″E, 35 m, ER19, sifted litter (leaf mold, rotten wood, 03–08 February 2002, coll. B.L. Fisher et al., BLF5316 (CASC PBI_OON 2766).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

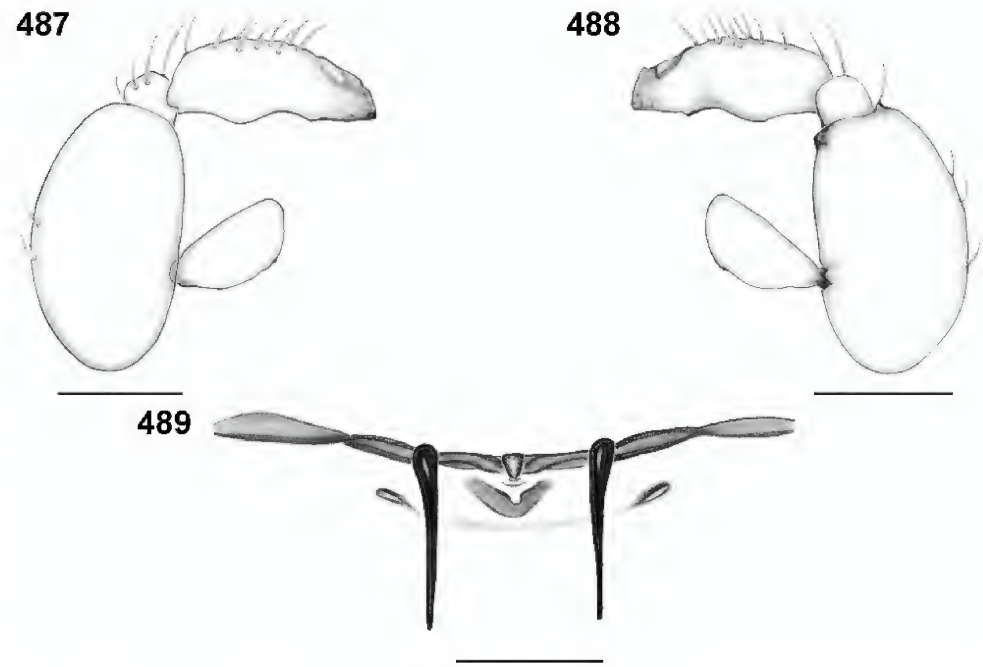
DIAGNOSIS: Males of *O. berenty* resemble those of *O. bemaraha* in having the shape of the cymbiobulbus, one third shorter than the patella, with a more or less round anterior edge, and the posterior edge of the cymbiobulbus in between the two posterior protuberances with a sharp, thin



Map 4. Specimen records of *Opopaea* species in Madagascar: *O. antsalova, antsiranana, berenty, concolor*, *namoroka,* and *tsingy*.



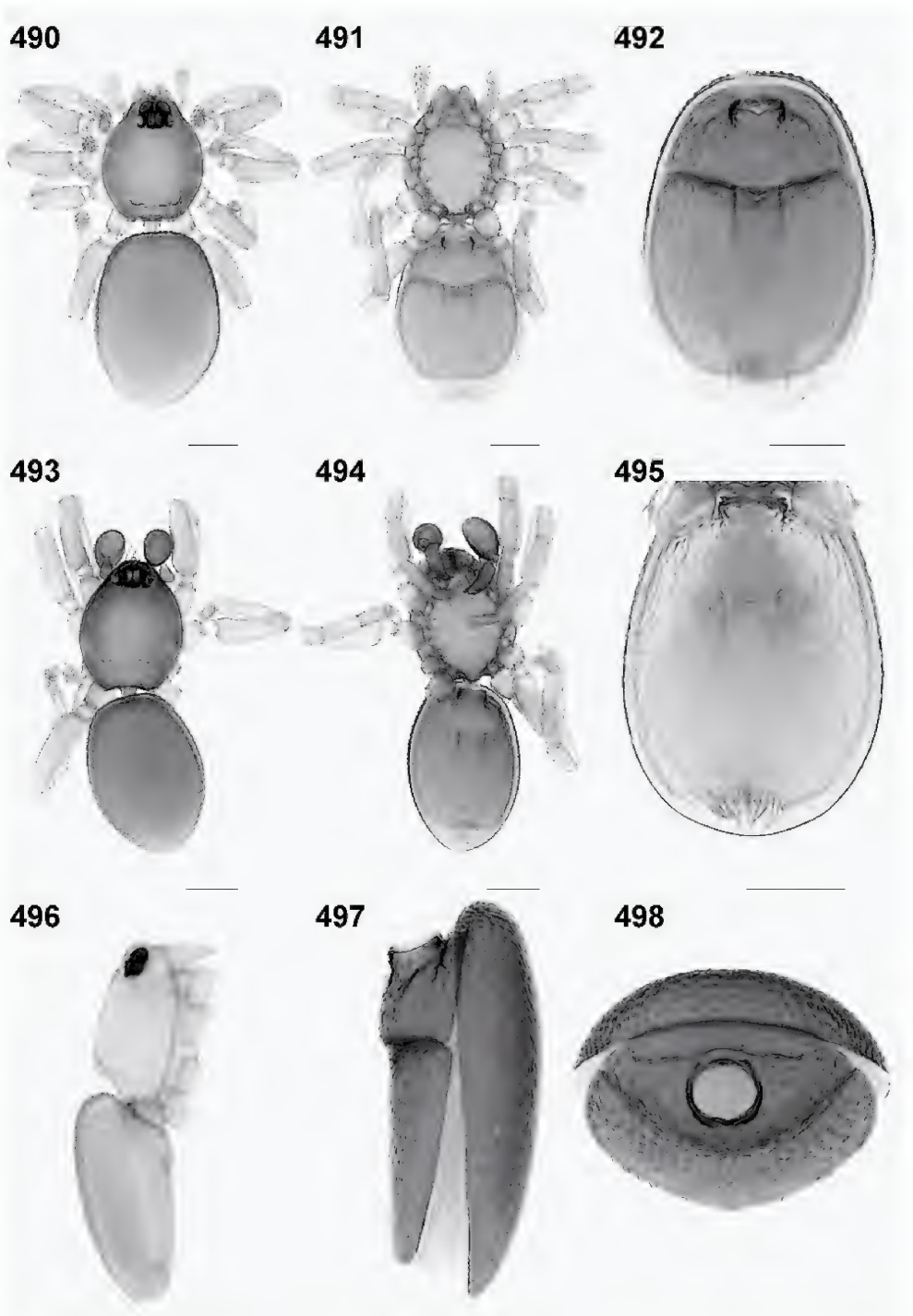
Figs. 478–486. *Opopaea foulpointe,* n. sp., male palp. **478.** Prolateral view. **479.** Retrolateral view. **480, 482.** Close up, prolateral view. **481, 483.** Retrolateral view. **484.** Embolar region, prolateral view. **485.** Anterior view. **486.** Retrolateral view. Scale bars: figures 478, 479 = 20 μm; figures 480, 481 = 15 μm; figures 482, 483 = 10 μm; figures 484–486 = 4 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.



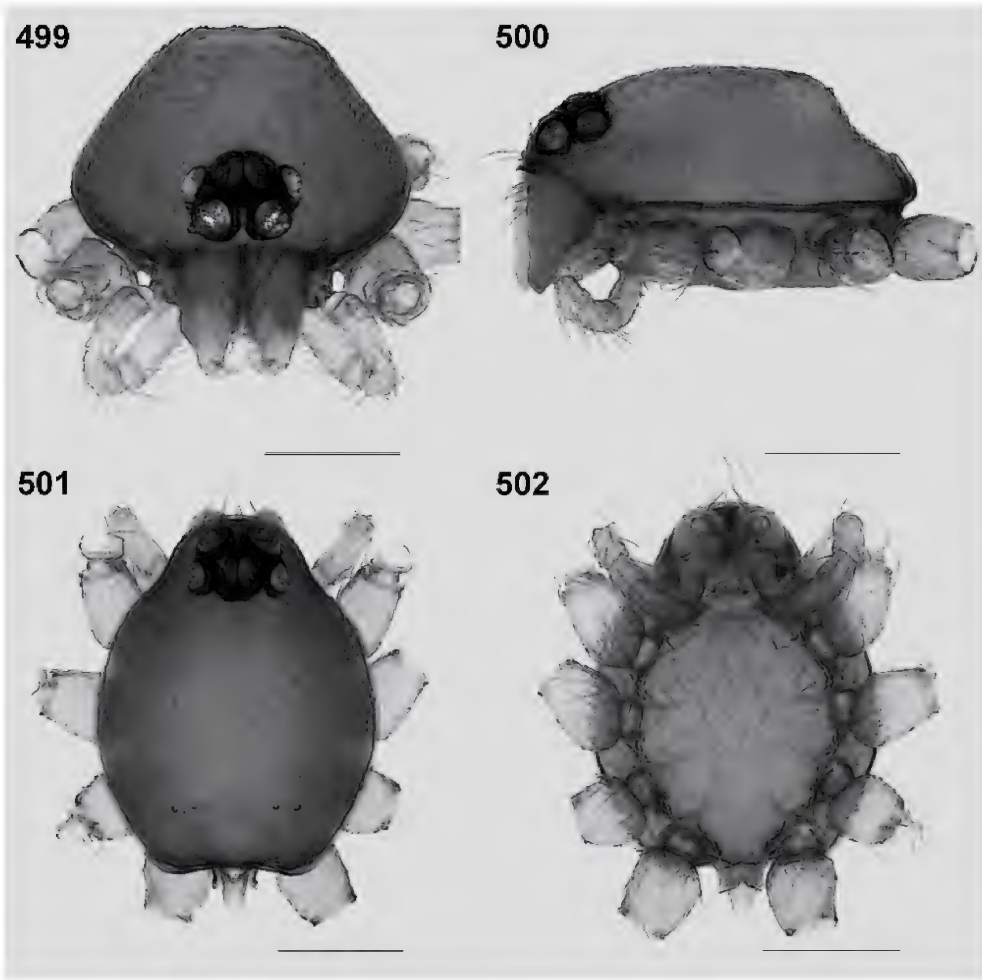
Figs. 487–489. *Opopaea itampolo,* n. sp. **487.** Male, palp, prolateral view. **488.** Retrolateral view. **489.** Epigynum, dorsal view. Scale bars: 0.1 mm.

bladelike area, but can be most easily distinguished by having the area below the palpal fenestra darkened and sclerotized on the retrolateral side (figs. 403, 407) and the shape of the abdomen laterally flattened (figs. 396, 397). Females of *O. berenty* are also very different from those of *O. bemaraha* and other *Opopaea* species in having a more or less wide V-shaped postgynum depression that opens posteriorly and with a nonsclerotized ridge (fig. 409). At the epigastric furrow the scutal ridge is a very thin, divided, and with a tiny parmula sitted on a rectangular sclerotized structure (figs. 392, 409–410).

DESCRIPTION: Male (holotype) (PBI_OON 2766). Small to medium-sized species. Total length 1.40. Color: yellowish orange to orange. Carapace: pars cephalica not elevated posteriorly with one row of two widely separated sets of two to three denticles (figs. 400, 401). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes medium to large. ALE largest. ALE and PME oval, PLE circular; PME darkened compared to other eyes, posterior eye row straight viewed from above, slightly procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, shape of posterior part between coxae IV hexagonal, constricted then slightly opened up laterally again near the end. Area between coxae III unmodified, without posterior lumps; setae sparse, densest at margins, originating from surface, without hair tufts (figs. 399–402). Palp cymbiobulbus tip with short, liplike, more or less sclerotized extensions on the anteroventral side, posterior margin with two protuberances: a smooth and large proximal one and the other small and sharp distally, separated by a sharp, thin bladelike area in between. Palpal fenestra large and elongated (oval), oriented more or less vertically and located near the end of the palp, area before fenestra anterior top not raised, round and short, slightly sclerotized, sloping downward toward the tip. Palpal femora about a half of the length of palpal patella and inserted



Figs. 490–498. *Opopaea itampolo,* n. sp. **490.** Female, habitus, dorsal view. **491.** Habitus, ventral view. **492.** Abdomen, ventral view. **493.** Male, habitus, dorsal view. **494.** Habitus, ventral view. **495.** Abdomen, ventral view. **496.** Habitus, lateral view. **497.** Abdomen, lateral view. **498.** Anterior view. Scale bars: 0.2 mm.



Figs. 499–502. *Opopaea itampolo,* n. sp., female. **499.** Carapace, anterior view. **500.** Lateral view. **501.** Dorsal view. **502.** Ventral view. Scale bars: 0.2 mm.

almost medially to it (figs. 387–388, 403–404, 407–408, 411–418).

Female (allotype) (PBI_OON 2766). Total length 1.57. Yellowish orange. Abdomen circular, much wider than carapace and flattened posteriorly toward posterior end (figs. 390–398). Postgynum depression ridge not sclerotized (figs. 389, 409–410).

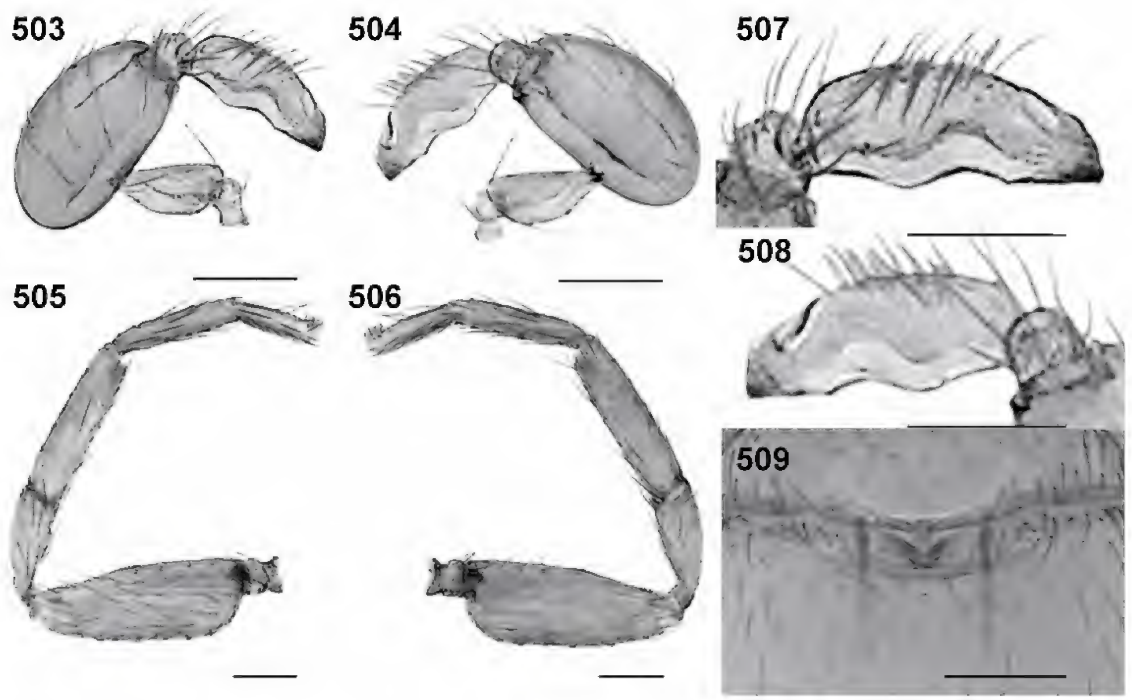
MEASUREMENTS: Male (PBI_OON 2766). TL: 1.40; CL: 0.63; CW: 0.50; CH: 0.31; AL: 0.83; AW: 0.55; ALE: 0.07; PME: 0.06; PLE: 0.05; EGW: 0.18; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; CBL: 0.18; CBW: 0.08; CBL/PTL: 0.75; FI: 0.11.

Female (allotype) (PBI_OON 34407). TL: 1.57; CL: 0.66; CW: 0.53; CH: 0.36; AL: 0.98; AW: 0.71; ALE: 0.08; PME: 0.06; PLE: 0.06; EGW: 0.19; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.01; EFL: 0.15; LAL: 0.08; PGI (LAL/EFL): 0.53; PDL/LAL: 0.5; PDW/EFL: 0.53.

VARIATION: Male: TL: 1.32–1.40; CL: 0.60–0.63; CW: 0.48–0.50; AL: 0.76–0.83; AW: 0.54–0.57.

Female: TL: 1.48–1.57; CL: 0.62–0.66; CW: 0.51–0.53; AL: 0.92–0.98; AW: 0.68–0.71.

NATURAL HISTORY: *O. berenty* was mostly found in tropical dry forests, gallery



Figs. 503–509. *Opopaea itampolo,* n. sp. **503.** Male, palp, prolateral view. **504.** Retrolateral view. **505.** Leg IV, prolateral view. **506.** Retrolateral view. **507.** Male, palp, close up, prolateral view. **508.** Retrolateral view. **509.** Epigynum, ventral view. Scale bars: figures 505, 506 = 0.2 mm; others = 0.1 mm.

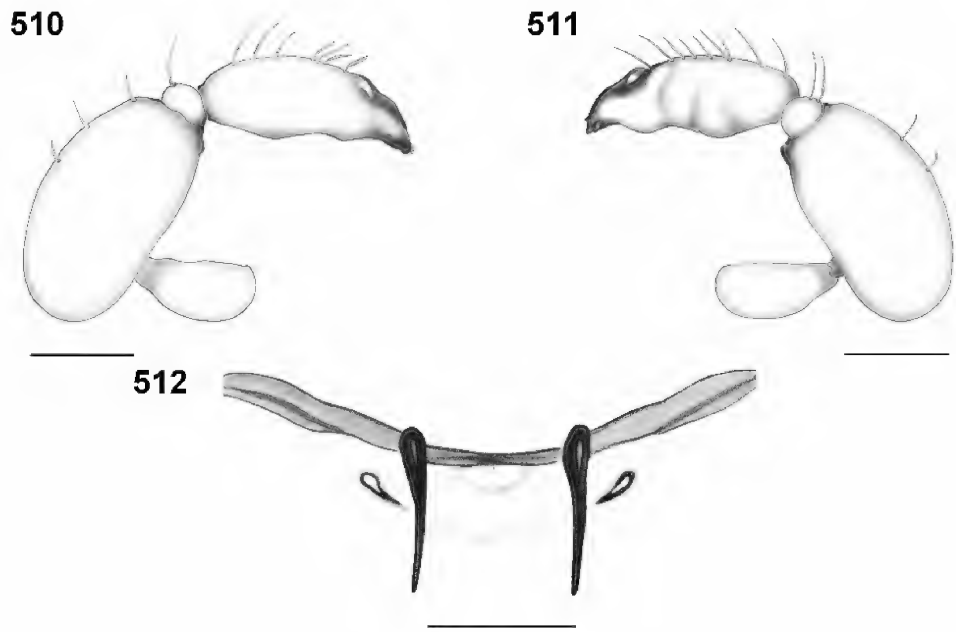
forests, and rainforests from 35–700 m elevations.

DISTRIBUTION: *O. berenty* is found mostly in the south and south-central regions of Madagascar in the provinces of Toliara and Fianarantsoa (Berenty, Cap Sainte-Marie, Forêt de Mité, Beza Mahafaly, Forêt d'Analalava) (map 4).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Toliara:** Réserve privée de Berenty, forêt de Bealoka, Mandraré river, 14.6 km 329° NNW Amboasary, gallery forest, 24°57′25″S, 46°16′17″E, 35 m, ER19, sifted litter (leaf mold, rotten wood, 03–08 February 2002, coll. B.L. Fisher et al., BLF5316 (CASC PBI_OON 2766), 112♂, 130♀. Réserve spéciale de Cap Sante Marie, 14.9 km 261° W Marovato, spiny forest/thicket, 25°35′40″S, 45°8′49″E, 160 m, EH11, sifted litter (leaf mold, rotten wood, 13–19 February 2002, coll. B.L. Fisher et al., BLF5570 (CASC PBI_OON 35050), 38♂, 31♀. Forêt de Mite, 20.7 km 29° WNW Tongobory, gallery forest, 23°31′27″S, 44°7′17″E, 75 m, ER19, sifted litter (leaf mold, rotten wood), 13 February–03 Mars 2002, coll. B.L. Fisher et al., BLF5858 (CASC PBI_OON 35046), 15♂, 15♀. Beza Mahafaly, 27 km E Betioky, rainforest, 23°39′S, 44°′E, 135 m, sifted litter, 23 April 1997, B.L. Fisher, BLF1476 (CASC PBI_OON 2238), 1♀. **Fianarantsoa:** Forêt d'Analalava, 29.6 km 280° W Ranohira, tropical dry forest, 22°35′30″S, 45°07′42″E, 700 m, EF19 sifted litter (leaf mold, rotten wood, 01–05 February 2003, C. Griswold and B. Fisher, et al., BLF7382 (CASC PBI_OON 3829), 1♀ (CASC PBI_OON 3812), 1♀.

Opopaea betioky, new species
Figures 21, 32, 419–451; map 3

TYPES: Male holotype and female allotype from Toliara province: 26.19 km ENE Betioky, RS Beza Mahafaly, 23°39′18.2″S, 44°37′58.8″E, 147 m, pitfalls, gallery forest, 18 January 2009, D.Andriamalala C. Griswold, G. Hormiga, A. Saucedo, N. Scharff and H. Wood (CASC. PBI_OON 35228).



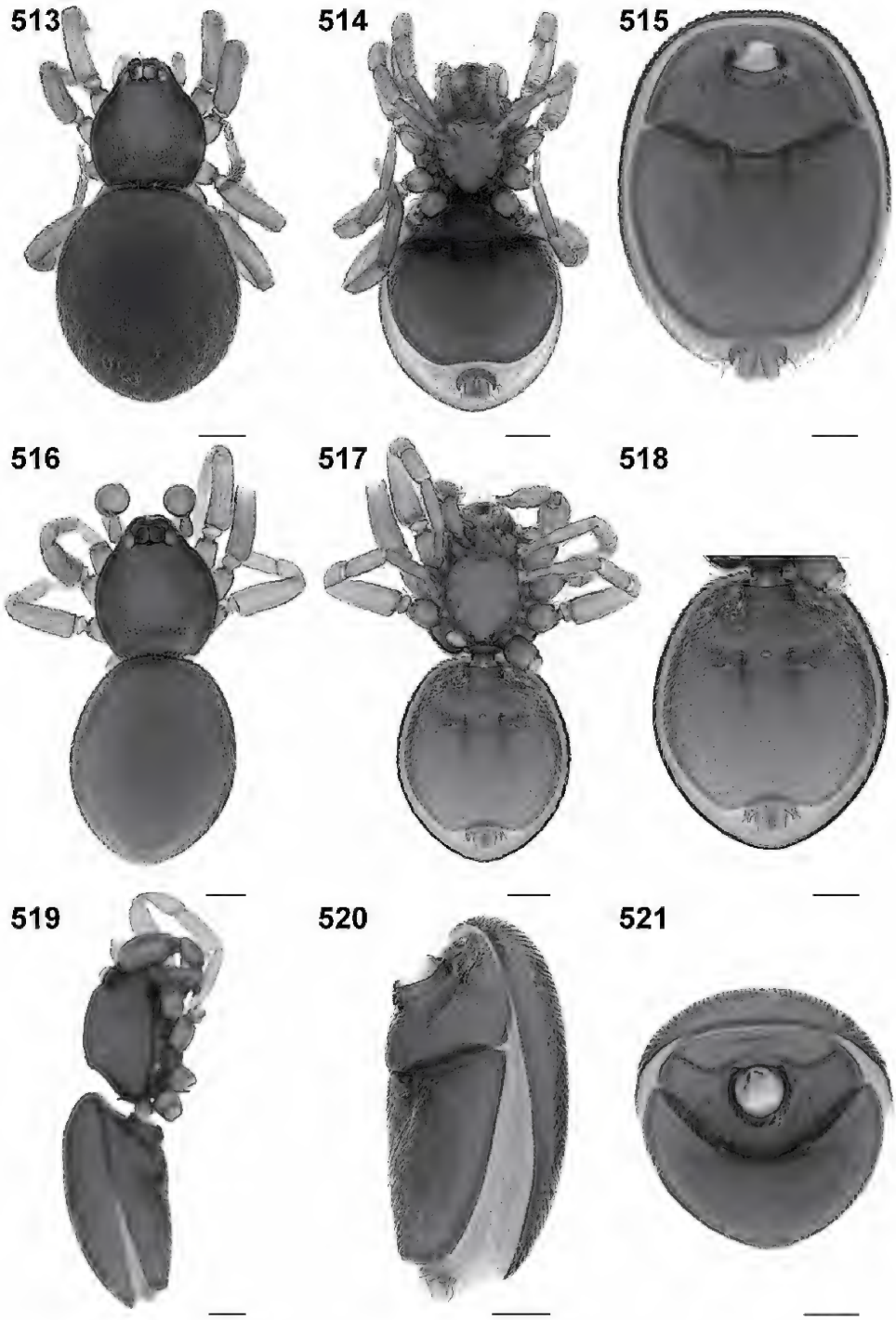
Figs. 510–512. *Opopaea kirindy,* n. sp. **510.** Male, palp prolateral view. **511.** Retrolateral view. **512.** Epigynum, dorsal view. Scale bars: 0.1 mm.

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

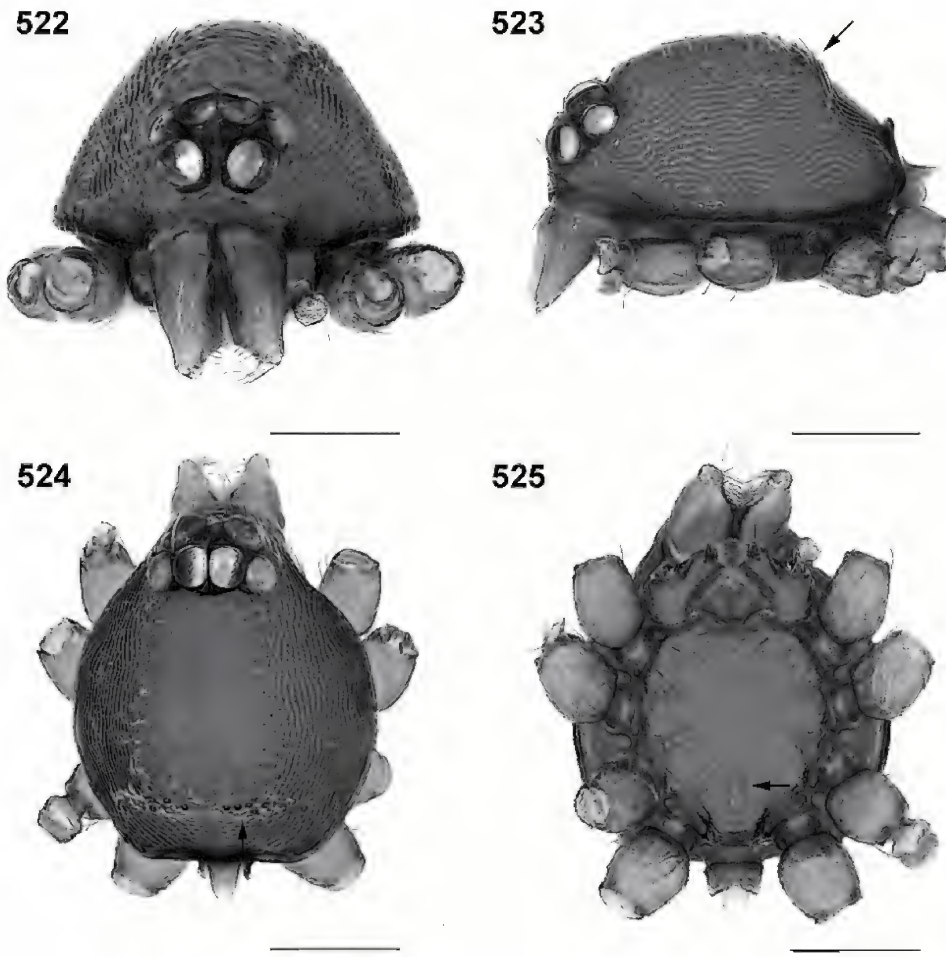
DIAGNOSIS: Males of *O. betioky* can most easily be distinguished from those of other *Opopaea* species by the posterodistal margin of their cymbiobulbus, which is thin, flattened, and sharp like a blade, and which continues toward the tip into a short, straight, forward-pointing sclerotized extension (figs. 435–436, 439–440). Females of *O. betioky* can be recognized by a thin and divided scutal ridge, sclerotized, and bearing medially a small parmula, whose base is more or less round and whose tip is more or less cylindrical (figs. 421, 441, 442).

DESCRIPTION: Male (holotype) (PBI_OON 35228). Small to medium-sized species. Total length 1.43. Color: yellowish orange to yellowish brown. Carapace: pars cephalica not elevated posteriorly with one row of two sets of two denticles and a hair (figs. 432, 433), carapace anteriorly narrowed to about one third its maximum width. Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes medium sized. ALE largest. ALE oval, PME and PLE circular; PME darkened compared to other eyes, posterior eye row straight viewed from above, slightly procurved from front; ALE separated by almost their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth and hairy, without pits, shape of posterior part between coxae IV more or less wide and hexagonal (fig. 434). Area between coxae III unmodified, without lumps; setae abundant, dark, needlelike, evenly distributed, originating from surface, without hair tufts (figs. 431–434). Palp cymbiobulbus shorter than patella, posterior margin with two protuberances, one large and proximal and one small, sharp, and distal. Palpal femora inserted almost medially to patella. Fenestra round, located at one third of the palp, top of fenestra not raised, area before fenestra more or less round and sclerotized toward the tip (figs. 419–420, 435–436, 439–440, 443–451).

Female (allotype) (PBI_OON 35228). Total length 1.57. Yellowish orange to yellowish brown, abdomen oval, and not flattened laterally toward posterior end, opercula large



Figs. 513–521. *Opopaea kirindy,* n. sp. **513.** Female, habitus, dorsal view. **514.** Habitus, ventral view. **515.** Abdomen, ventral view. **516.** Male, habitus, dorsal view. **517.** Ventral view. **518.** Abdomen, ventral view. **519.** Habitus, lateral view. **520.** Abdomen, lateral view. **521.** Anterior view. Scale bars: 0.2 mm.



Figs. 522–525. *Opopaea kirindy,* n. sp., male. **522.** Carapace, anterior view. **523.** Lateral view. **524.** Dorsal view. **525.** Ventral view. Scale bars: 0.2 mm.

but not darkened (figs. 421, 441, 442). Postgynum depression very short, narrow, and not sclerotized (figs. 421, 422–430).

MEASUREMENTS: Male (holotype) (PBI_OON 35228). TL: 1.43; CL: 0.61; CW: 0.49; CH: 0.24; AL: 0.87; AW: 0.54; ALE: 0.07; PME: 0.06; PLE: 0.06; EGW: 0.20; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; CBL: 0.18; CBW: 0.07; CBL/PTL: 0.78; FI: 0.11.

Female (allotype) (PBI_OON 35228). TL: 1.57; CL: 0.61; CW: 0.47; CH: 0.25; AL: 0.95; AW: 0.60; ALE: 0.06; PME: 0.05; PLE: 0.05; EGW: 0.17; ALE-ALE: 0.03; ALE-PLE: 0; PME-PME: 0; PLE-PME: 0.01; EFL: 0.14; LAL: 0.06; PGI (LAL/EFL): 0.43; PDL/LAL: 0.66; PDW/EFL: 0.43.

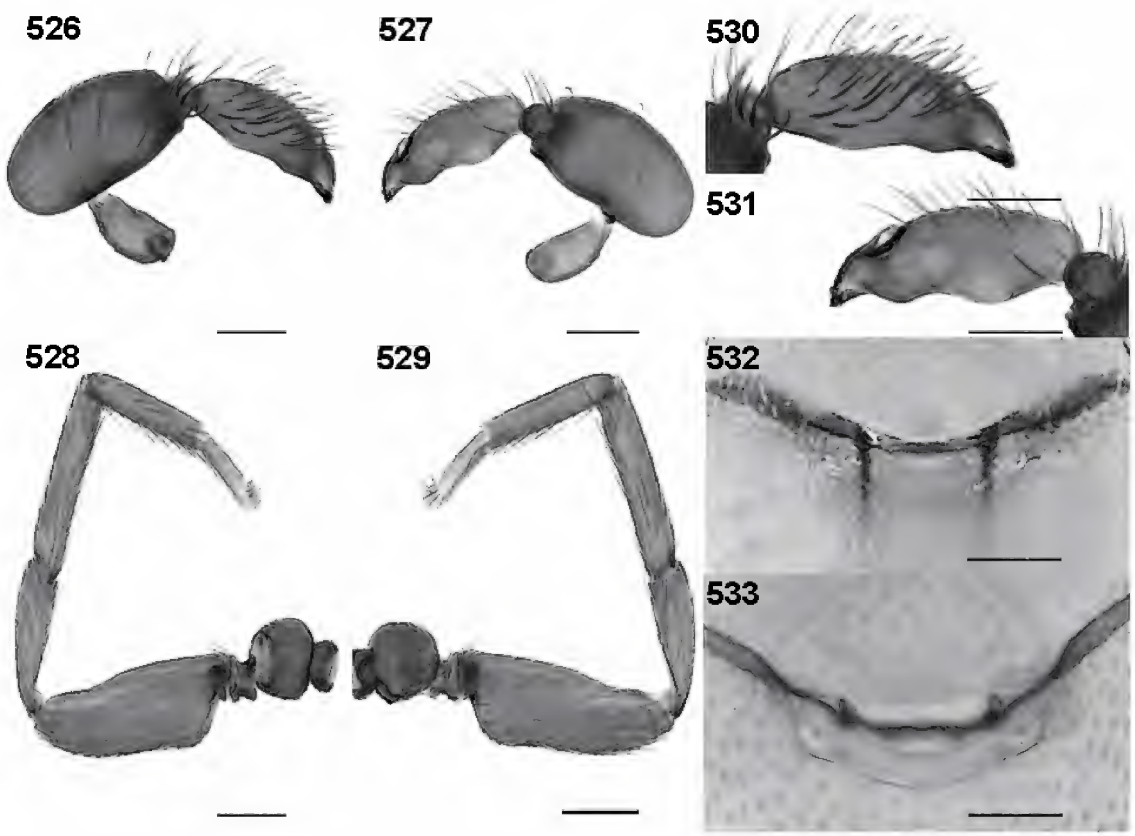
VARIATION: Male: TL: 1.33–1.43; CL: 0.61–0.61; CW: 0.47–0.49; AL: 0.77–0.87; AW: 0.48–0.54.

Female: TL: 1.44–1.57; CL: 0.61–0.63; CW: 0.47–0.49; AL: 0.87–0.95; AW: 0.58–0.60.

NATURAL HISTORY: *O. betioky* was mostly found in gallery forest, tropical deciduous forest from 147–159 m elevations.

DISTRIBUTION: *O. betioky* was mostly found in the south and southwestern regions of Madagascar in the provinces of Toliara and Mahajanga (Beza Mahafaly, Ankarafantsika) (map 3).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Toliara:** 26.19 km ENE Betioky, RS Beza Mahafaly, 23°39′18.2″S, 44°37′58.8″E, 147 m, winklers, gallery forest, 18 January



Figs. 526–533. *Opopaea kirindy,* n. sp. **526.** Male, palp, prolateral view. **527.** Retrolateral view. **528.** Leg IV, prolateral view. **529.** Retrolateral view. **530.** Male, palp, close up, prolateral view. **531.** Retrolateral view. **532.** Epigynum, ventral view. **533.** Dorsal view. Scale bars: figures 528, 529 = 0.2 mm; others = 0.1 mm.

2009, D. Andriamalala, C. Griswold, G. Hormiga, A. Saucedo, N. Scharff and H. Wood (CASC PBI_OON 35242) 1♀. (CASC PBI_OON 35228), 1♂, 3♀ (CASC. PBI_OON 35226), 1♂, 1♀ (AMNH PBI_OON 35200), 1♀ (CASC PBI_OON 00035230), 1♀ (CASC PBI_OON 35201), 1♀ (CASC PBI_OON 34354), 1♀. **Mahajanga:** 28.87 km SSE Marovoay, PN Ankarafantsika, 16°19′10″S, 46°48′25.1″E, 159 m, pitfalls, secondary tropical deciduous forest, 26 January 2009, D. Andriamalala, C. Griswold, G. Hormiga, A. Saucedo, N. Scharff and H. Wood (CASC PBI_OON 35225), 1♀.

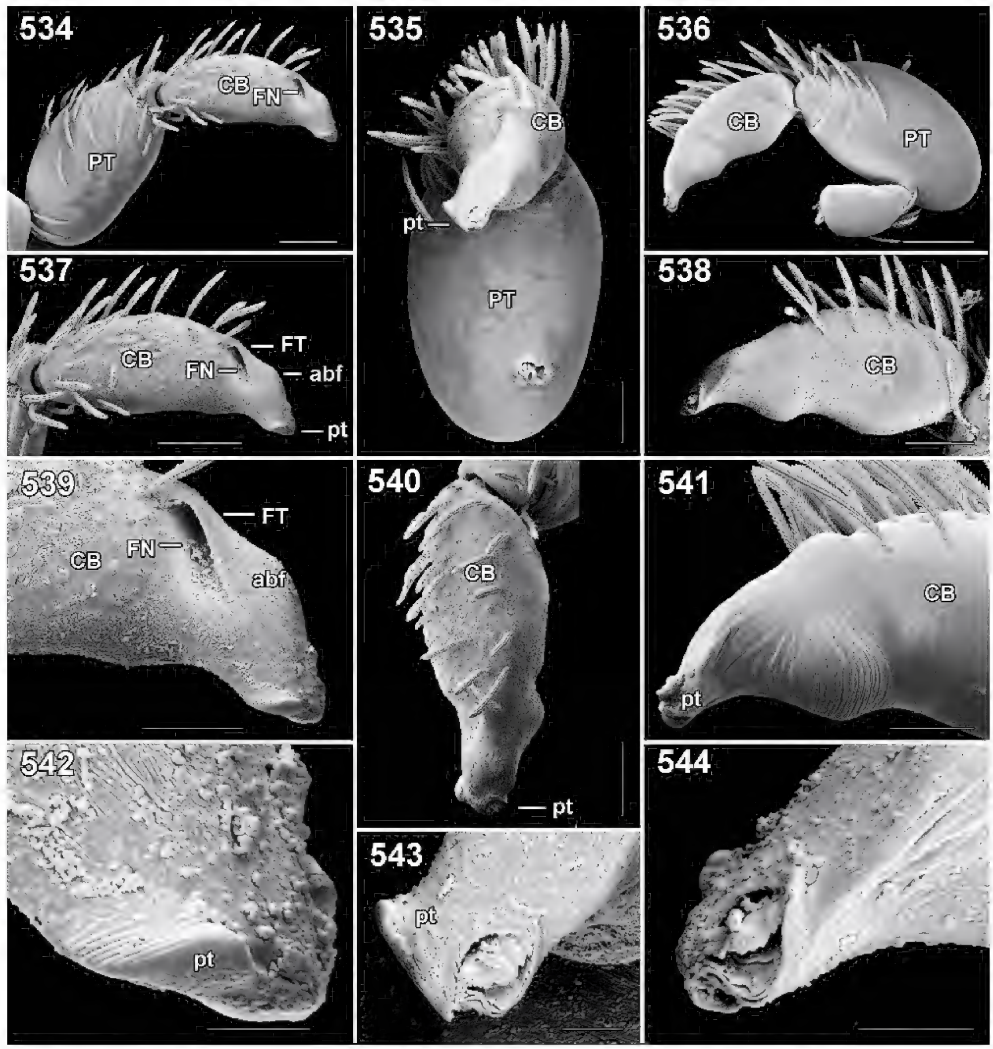
Opopaea foulpointe, new species
Figures 14, 17, 26, 39, 452–486; map 3

TYPES: Male holotype and female allotype from Foulpointe, Toamasina province, Madagascar, forêt de la lagune, bac jaune, October 1993, Pauly A. (MRAC PBI_OON 9793).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

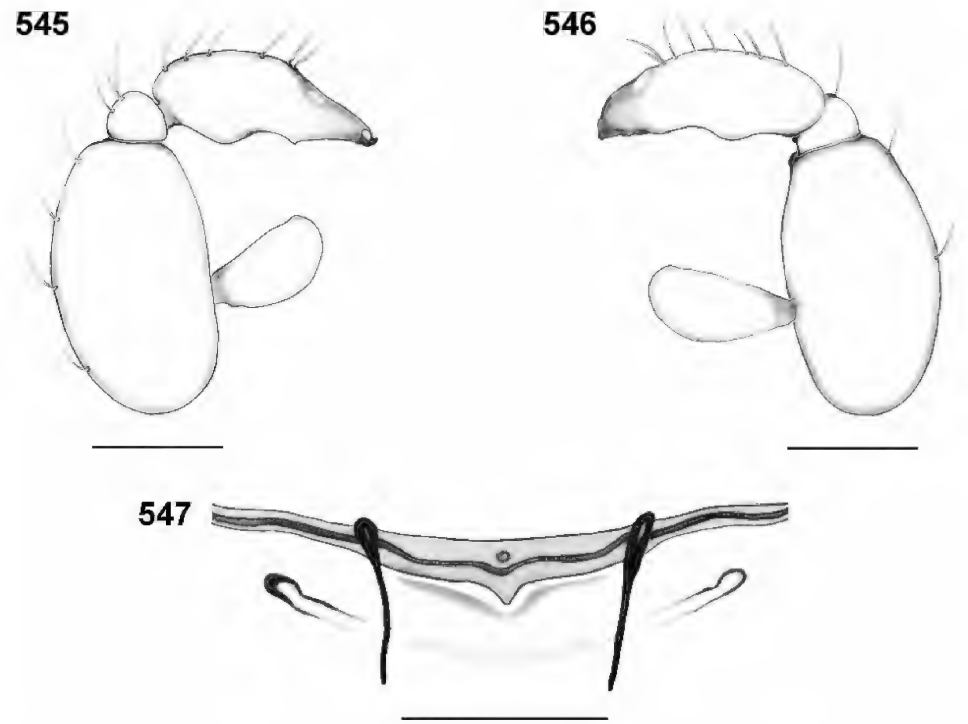
DIAGNOSIS: Males of *O. foulpointe* can be easily be distinguished from those of other *Opopaea* species by a cymbiobulbus longer and slightly wider compared to the patella, with the anterior margin thick, resembling a parrot beak (rising anteriorly before descending abruptly into a steep slope) (figs. 452, 453, 470, 471, 474, 475, 478–486). Females of *O. foulpointe* can be easily recognized by the very simple epigynum with a slitlike postgynum depression and a very thin scutal ridge, evenly sclerotized, bearing a very small circular parmula in its median (figs. 454, 476, 477).

DESCRIPTION: Male (holotype) (PBI_OON 9793). Medium-sized species. Total



Figs. 534–544. *Opopaea kirindy,* n. sp., male palp. **534.** Prolateral view. **535.** Anterior view. **536.** Retrolateral view. **537, 539.** Close up, prolateral view. **540.** Anterior view. **538, 541.** Close up, retrolateral view. **542.** Embolar region, prolateral view. **543.** Anterior view. **544.** Retrolateral view. Scale bars: figures 534, 536 = 60 μm; figure 535 = 20 μm; figures 537–541 = 40 μm; figures 542–544 = 10 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

length 1.60. Color: brownish orange. Carapace: pars cephalica slightly elevated posteriorly with one row of two sets of four denticles, three aligned horizontally and the last one placed vertically to the third one (figs. 465, 467). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum present, undivided. Cheliceral paturons long, thin, with proximal bosses, directed obliquely, usually detached from the posterior margin of the clypeus (fig. 465). Eyes medium sized. ALE and PME largest. ALE, PME, and PLE oval; PME darkened compared to other eyes, posterior eye row straight viewed from above, slightly procurved from front; ALE, ALE-PLE, and PLE-PME separated by less than their radius, PME touching throughout most of their length. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, shape of posterior part between coxae IV constricted



Figs. 545–547. *Opopaea mahafaly,* n. sp. **545.** Male, palp prolateral view. **546.** Retrolateral view. **547.** Epigynum, dorsal view. Scale bars: 0.1 mm.

then enlarged posteriorly, slightly swollen, especially in males (figs. 468, 469). Area in front of coxae III, each with two lateral lumps, setae abundant, evenly distributed, originating from surface, without hair tufts (figs. 466, 468, 469). Posterior margin of cymbiobulbus with two huge protuberances, both distally and proximally. Fenestra circular, anterior top not sclerotized. Palpal femora almost the same length as palpal patella and inserted at the posterior end of patella (figs. 452, 453, 470, 471, 474, 475, 478–486).

Female (allotype) (PBI_OON 9793). Total length 1.56. Shape of posterior part between coxae IV slightly constricted but not swollen and area in front of coxae III without lumps. Color orange, abdomen oval and not flattened posteriorly. Postgynum depression very short and wide, about one fourth longer to the distance between epigastric furrow and the shallow groove connecting the tracheal spiracles and almost as wide as the distance between the lateral apodemes, ridge weakly sclerotized (figs. 454, 476, 477).

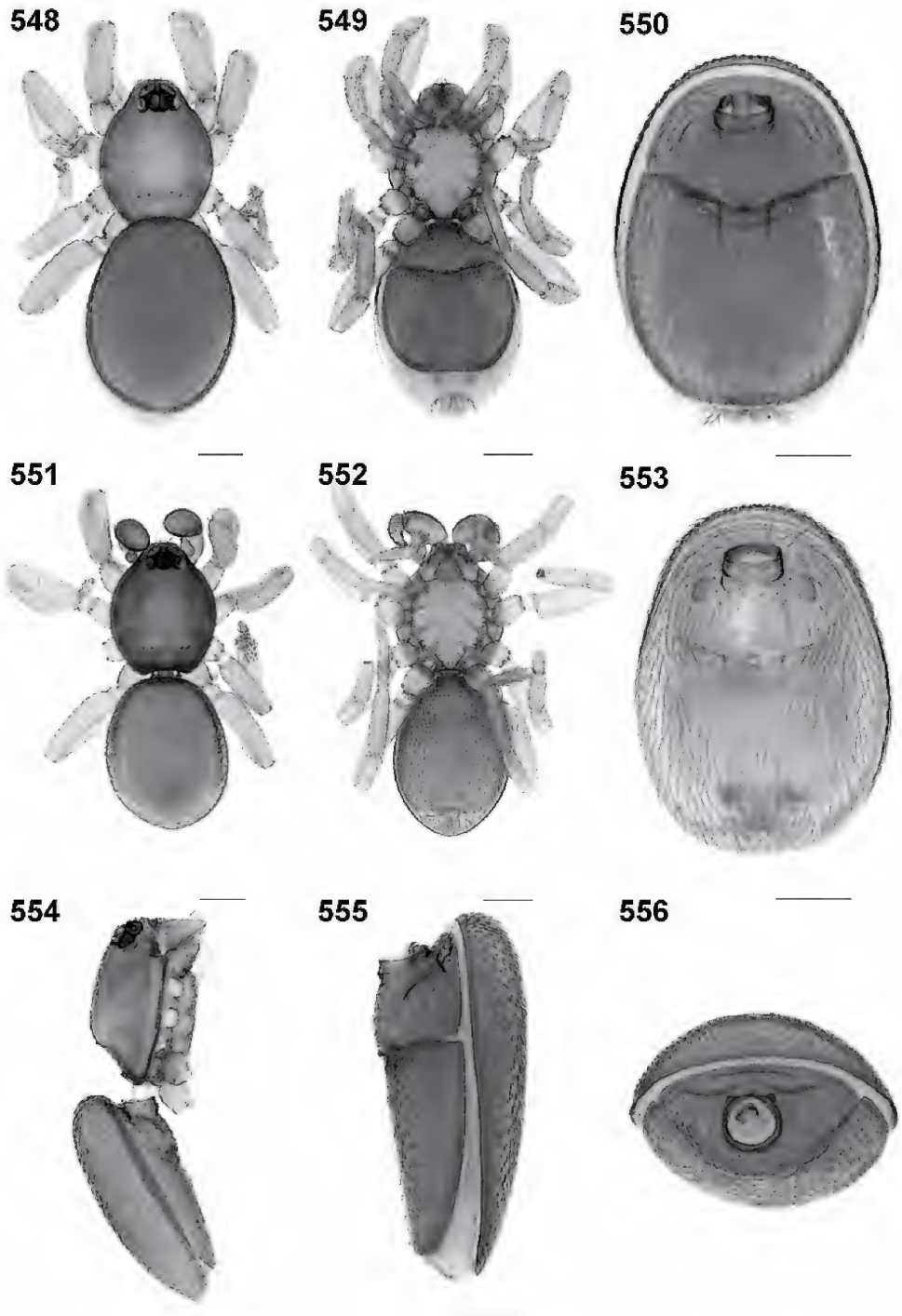
MEASUREMENTS: Male (holotype) (PBI_OON 9793). TL: 1.60; CL: 0.66; CW: 0.54; CH: 0.32; AL: 0.95; AW: 0.61; ALE: 0.08; PME: 0.08; PLE: 0.07; EGW: 0.21; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; CBL: 0.22; CBW: 0.1; CBL/PTL: 1.22; FI: 0.04.

Female (allotype) (PBI_OON 9793). TL: 1.76; CL: 0.71; CW: 0.55; CH: 0.30; AL: 1.11; AW: 0.72; ALE: 0.09; PME: 0.09; PLE: 0.06; EGW: 0.20; ALE-ALE: 0.04; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.01; EFL: 0.18; LAL: 0.08; PGI (LAL/EFL): 0.44; PDL/LAL: 0.37; PDW/EFL: 1.

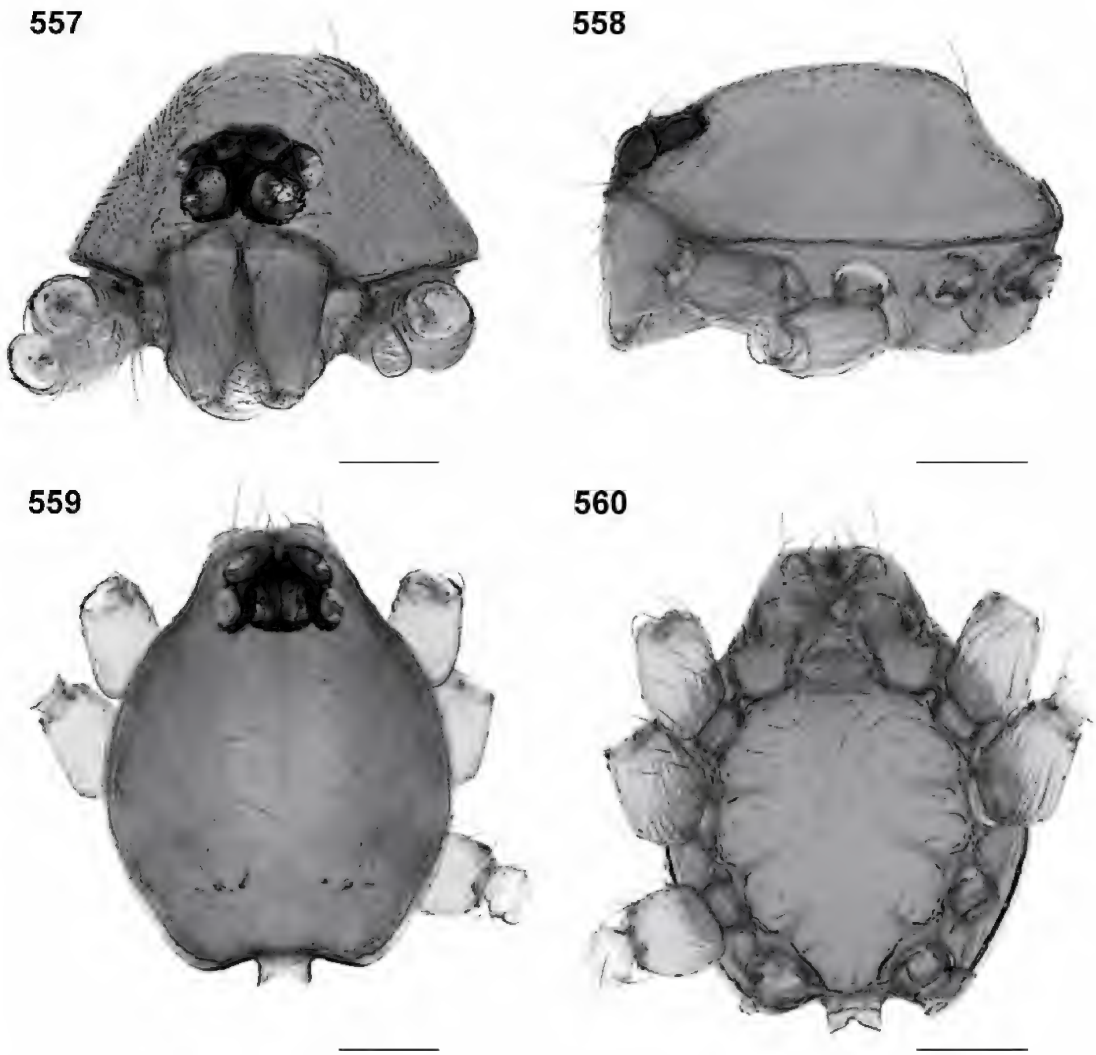
VARIATION: Male: TL: 1.60–1.64; CL: 0.70–0.71; CW: 0.54–0.56; AL: 0.90–0.95; AW: 0.59–0.61.

NATURAL HISTORY: *O. foulpointe* was found near the beach, on red soil, in leaf litter near roads and in gardens.

DISTRIBUTION: *O. foulpointe* was found along the east coast of Madagascar in the province of Toamasina, and on the nearby island of Mohéli (Comoros) and on the coast of Kenya, around the town of Kilifi (map 3).



Figs. 548–556. *Opopaea mahafaly,* n. sp. **548.** Female, habitus, dorsal view. **549.** Habitus, ventral view. **550.** Abdomen, ventral view. **551.** Male, habitus, dorsal view. **552.** Habitus, ventral view. **553.** Abdomen, ventral view. **554.** Habitus, lateral view. **555.** Abdomen, lateral view. **556.** Anterior view. Scale bars: 0.2 mm.



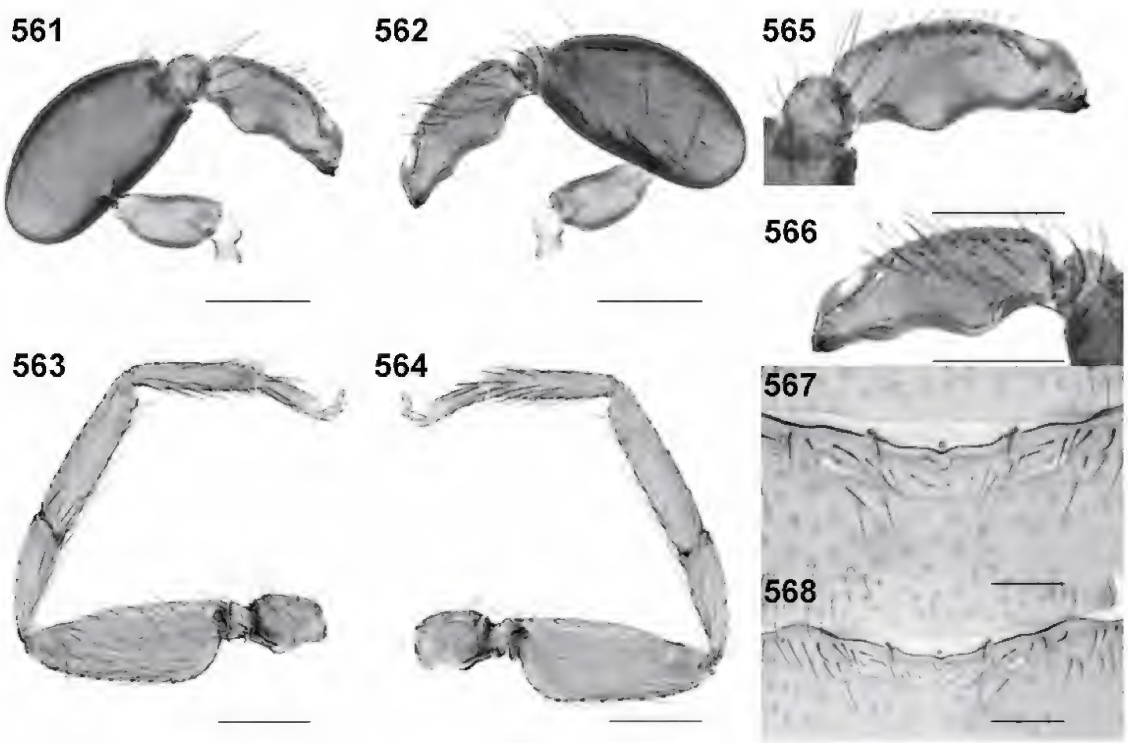
Figs. 557–560. *Opopaea mahafaly,* n. sp., female. **557.** Carapace, anterior view. **558.** Lateral view. **559.** Dorsal view. **560.** Ventral view. Scale bars: 0.2 mm.

OTHER MATERIAL EXAMINED: MADAGASCAR: **Toamasina:** Foulpointe, forêt de la lagune, bac jaune, October 1993, Pauly A. (MRAC PBI_OON 9793), 2♂. Forêt sur terre rouge, Tamisage litière, November 1994, Pauly A. (MRAC PBI_OON 9798), 1♂. COMOROS: **Mohéli:** Ikoni River, litter on road, sieving, 22 May 2003, Jocqué R. and Van den Spiegel (MRAC PBI_OON 28631), 1♂. KENYA: Kilifi: Kenya coast. 30 m, garden, 19 September 1977, B. Fulton coll., Fand J.M. (MNH PBI_OON 31227), 3♂, 1♀.

Opopaea itampolo, new species
Figures 487–509; map 3

TYPES: Male holotype and female allotype from Toliara province, Mahafaly plateau, 6.2 km 74° ENE Itampolo, spiny forest/thicket, 18°48′22″S, 48°20′13″E, 1068 m, EH11, sifted litter (leaf mold, rotten wood), 21–25 February 2002, coll. B.L. Fisher et al. (CASC PBI_OON 35036).

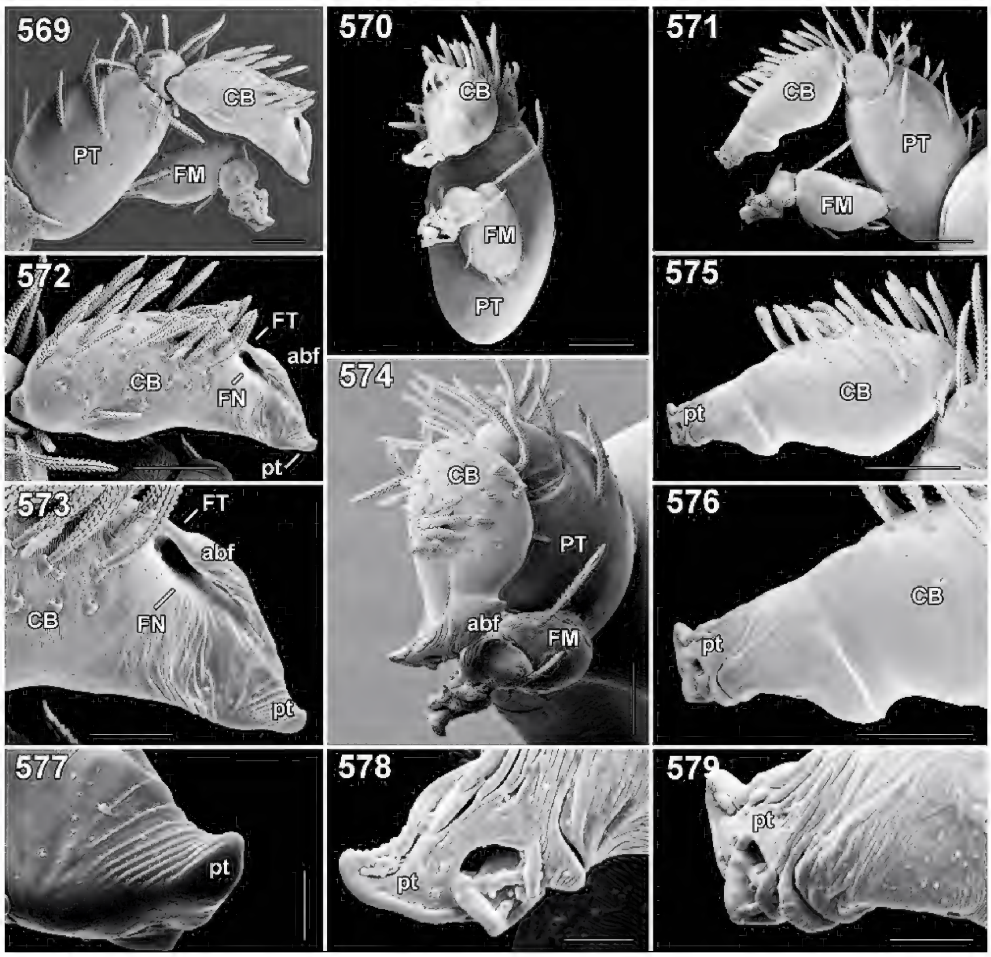
ETYMOLOGY: The species is named after the Malagasy tribe from the type locality.



Figs. 561–568. *Opopaea mahafaly,* n. sp. **561.** Male, palp, prolateral view. **562.** Retrolateral view. **563.** Leg IV, prolateral view. **564.** Retrolateral view. **565.** Male, palp, close up, prolateral view. **566.** Retrolateral view. **567.** Epigynum, ventral view. **568.** Dorsal view. Scale bars: figures 592, 593 = 0.2 mm; others = 0.1 mm.

DIAGNOSIS: Males of *O. itampolo* can be easily distinguished from those of other *Opopaea* species by the very simple cymbiobulbus tapering anteriorly, thinner but almost the same size as the patella, with a buttonlike and more or less sclerotized tip (figs. 130, 131, 538, 539, 542, 543). Females of *O. itampolo* resemble those of *O. berenty* and *O. antsalova* by having a V-shaped postgynum depression, but in *O. itampolo* the V-shape is very long, reaching the shallow groove connecting the two tracheal spiracles, and the postgynum depression ridge is very thick and sclerotized (figs. 489, 509).

DESCRIPTION: Male (holotype) (PBI_OON 35036). Small species. Total length 1.22. Color: yellowish orange. Carapace: pars cephalica not elevated posteriorly with one row of two widely separated sets of two denticles (figs. 500, 501). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes medium sized to large. ALE and PME largest. ALE oval, PME and PLE circular; PME darkened compared to other eyes; posterior eye row straight viewed from above, procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, shape of posterior part between coxae IV hexagonal, slightly open up laterally near the end. Lateral margins of area between coxae III unmodified, without lumps; setae abundant, evenly distributed, originating from surface, without hair tufts (figs. 482–502). Palp posterior margin with two barely visible protuberances: a smooth and very wide proximal one and a small and more pointed distal one. Palpal fenestra elongated (oval), oriented obliquely and located at one third the length of the palp, fenestra top not raised, area before fenestra



Figs. 569–579. *Opopaea mahafaly,* n. sp., male palp. **569.** Prolateral view. **570, 574.** Anterior view. **571.** Retrolateral view. **572, 573.** Close up, prolateral view. **575–576.** Retrolateral view. **577.** Embolar region, prolateral view. **578.** Anterior view. **579.** Retrolateral view. Scale bars: figures 569–571; figure 574 = 40 μm; figures 572, 575 = 20 μm; figures 573, 576 = 10 μm; figures 577–579 = 4 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

slightly sclerotized. Palpal femora about one half the length of palpal patella and inserted almost medially to it (figs. 487, 488, 503, 504, 507, 508).

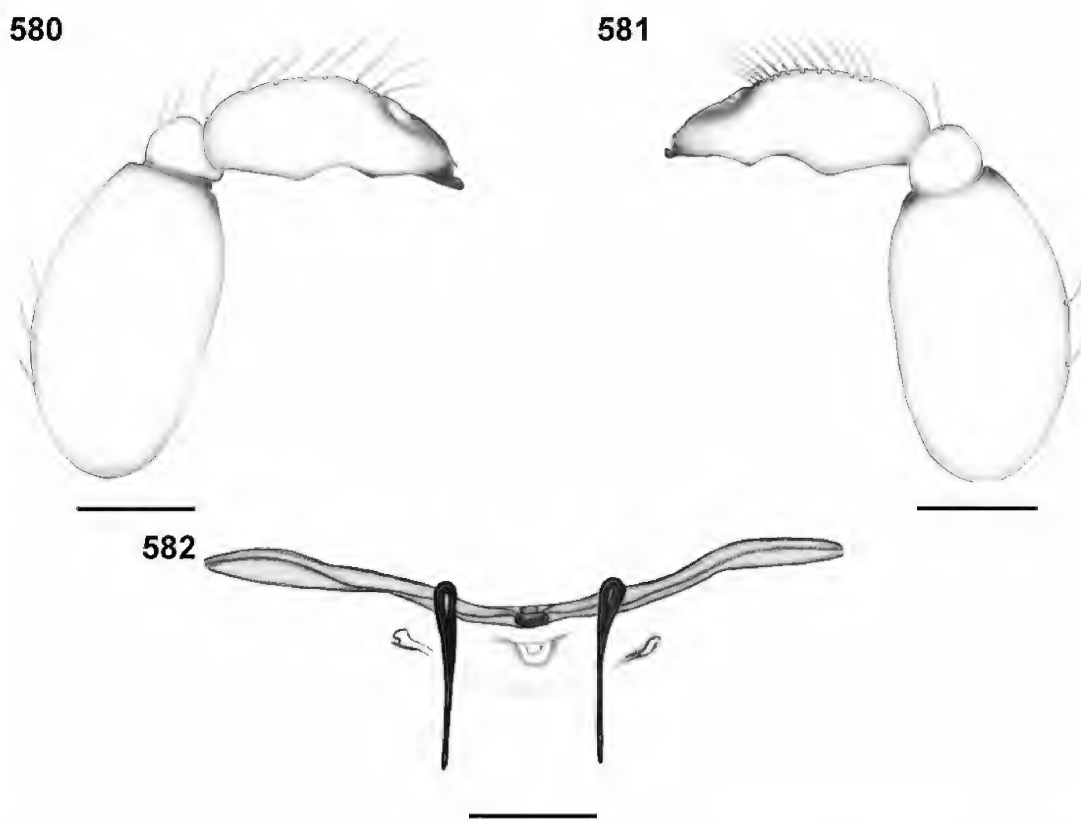
Female (allotype) (PBI_OON 35036). Total length 1.42. Yellowish orange, abdomen oval and not flattened posteriorly. Epigastric scutal ridge not divided, sclerotized, and bearing an inverted triangle-shaped parmula across its median part (figs. 489, 509).

MEASUREMENTS: Male (holotype) (PBI_OON 35036). TL: 1.22; CL: 0.58; CW: 0.47; CH: 0.30; AL: 0.70; AW: 0.50; ALE: 0.07; PME: 0.07; PLE: 0.06; EGW: 0.19; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; CBL: 0.16; CBW: 0.08; CBL/PTL: 0.72; FI: 0.11.

Female (allotype) (PBI_OON 35036). TL: 1.42; CL: 0.59; CW: 0.47; CH: 0.28; AL: 0.82; AW: 0.57; ALE: 0.08; PME: 0.06; PLE: 0.06; EGW: 0.17; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; EFL: 0.13; LAL: 0.06; PGI (LAL/EFL): 0.46; PDL/LAL: 0.83; PDW/EFL: 0.46.

VARIATION: Male: TL: 1.22–1.22; CL: 0.56–0.58; CW: 0.44–0.47; AL: 0.67–0.70; AW: 0.48–0.50.

Female: TL: 1.40–1.42; CL: 0.59–0.61; CW: 0.47–0.47; AL: 0.82–0.84; AW: 0.57–0.62.



Figs. 580–582. *Opopaea manderano,* n. sp. **580.** Male, palp prolateral view. **581.** Retrolateral view. **582.** Epigynum, dorsal view. Scale bars: 0.1 mm.

NATURAL HISTORY: *O. itampolo* was mostly found in spiny forest at 1068 m elevation.

DISTRIBUTION: *O. itampolo* mostly found in southern Madagascar in the province of Toliara (Itampolo, Tsimanampetsotsa) (map 3).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Toliara:** Mahafaly plateau, 6.2 km 74° ENE Itampolo, spiny forest/thicket, 18°48′22″S, 48°20′13″E, 1068 m, EH11, sifted litter (leaf mold, rotten wood, 21–25 February 2002, coll. B.L. Fisher et al. (CASC PBI_OON 35036), 1♂, 1♀.

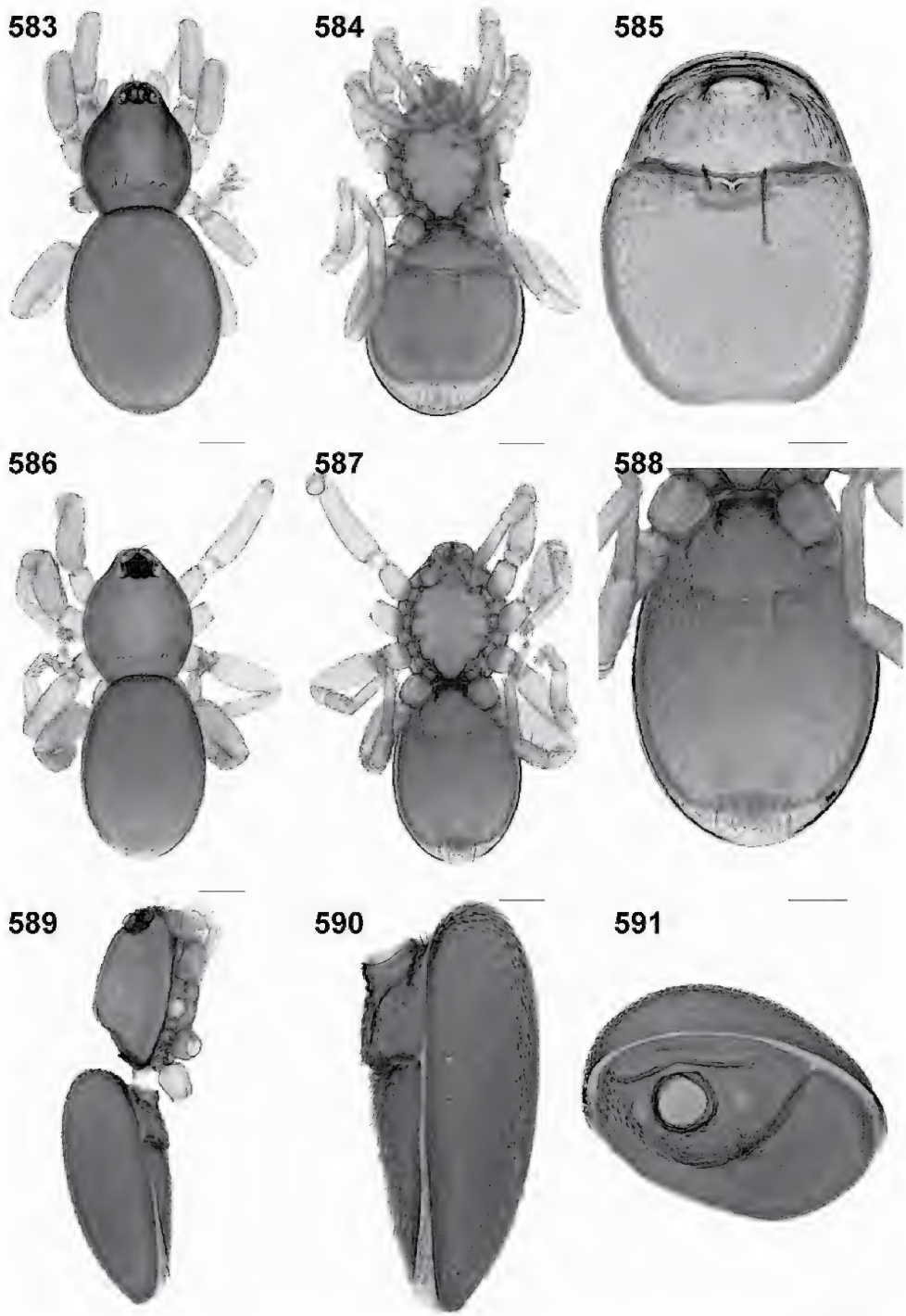
Opopaea kirindy, new species
Figures 510–544; map 1

TYPES: Male holotype and female allotype from Toliara province, 48 km ENE Morondava, 20°04″S, 44°39″E, 30 m, general collecting, tropical dry, 04–10 January 1991, P.M. Olson (MCZ PBI_OON 28203).

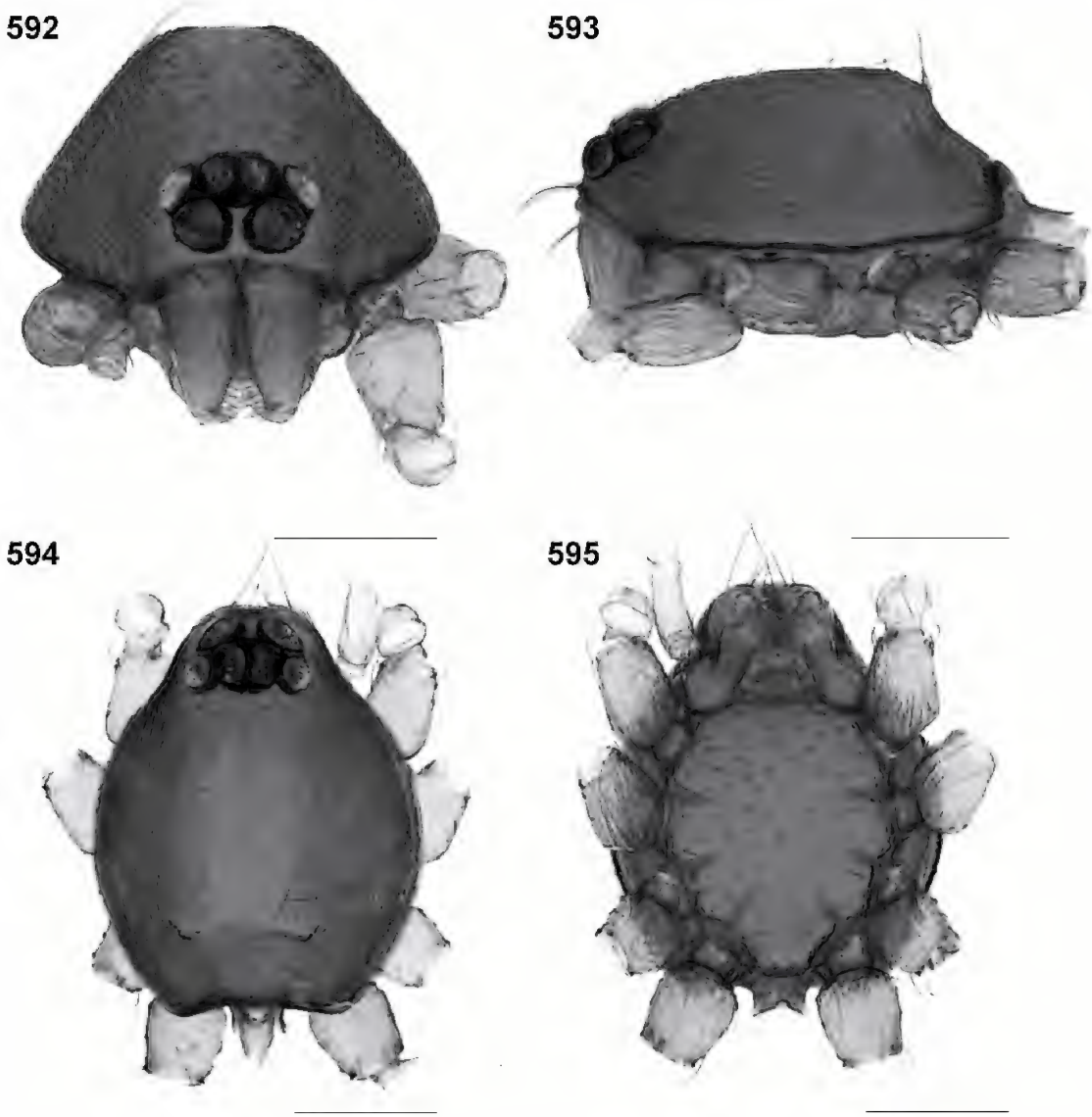
ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. kirindy* can be distinguished from those of other *Opopaea species* by their cymbiobulbus longer than the patella, tapering toward a tubular and sclerotized tip, which curves downward. Posterior edge of fenestra thick and heavily sclerotized (figs. 510, 511, 526, 527, 530, 531). Females of *O. kirindy* can be easily recognized by a thick and sclerotized epigynal scutal ridge, and a parmula almost invisible dorsally, round, small, and hanging below the posterior edge of the scutal ridge (figs. 512, 532, 533).

DESCRIPTION: Male (holotype) (PBI_OON 28203). Large and very hairy species. Total length 1.96. Color: dark orange. Carapace: pars cephalica strongly elevated medially with numerous rows of thick and stiff hairs (figs. 523, 524). Carapace anterolateral corners without sclerotized triangular

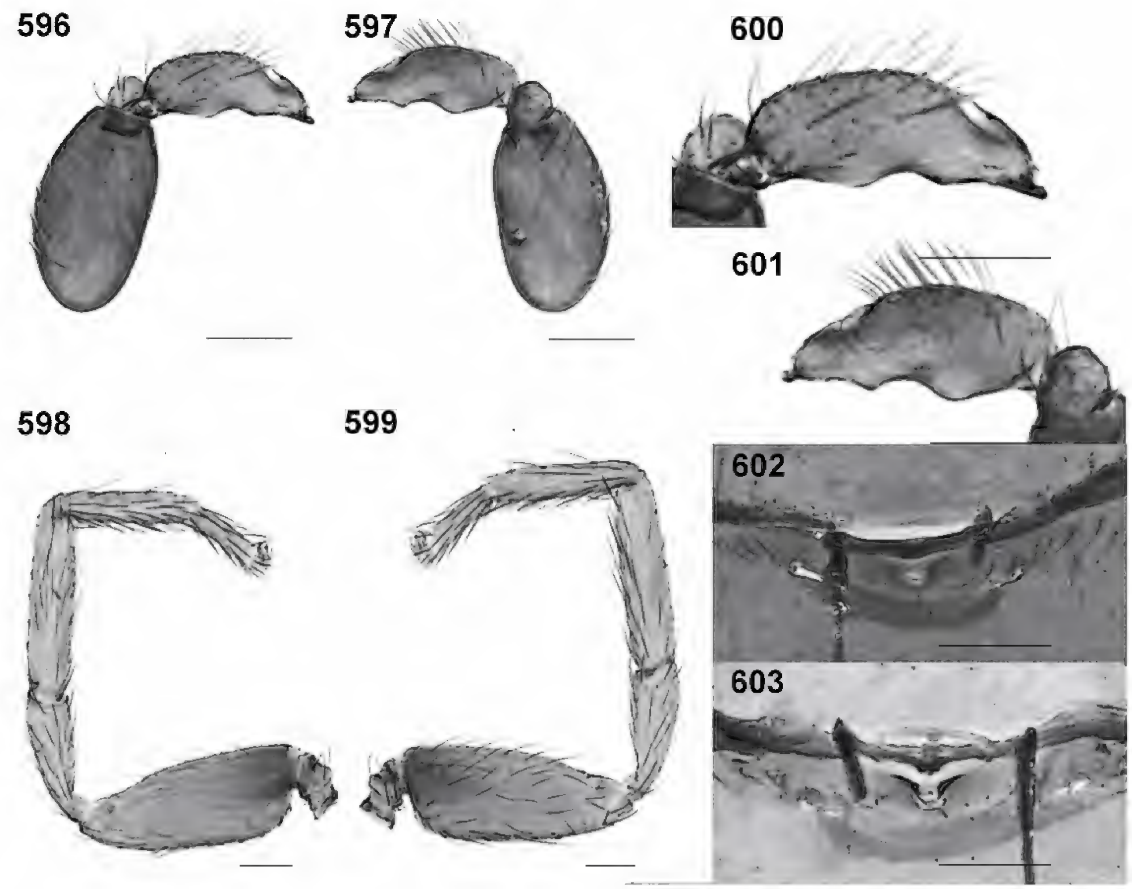


Figs. 583–591. *Opopaea manderano,* n. sp. **583.** Female, habitus, dorsal view. 584. Habitus, ventral view. **585.** Abdomen, ventral view. **586.** Male, habitus, dorsal view. **587.** Habitus, ventral view. **588.** Abdomen, ventral view. **589.** Habitus, lateral view. **590.** Abdomen, lateral view. **591.** Anterior view. Scale bars: 0.2 mm.



Figs. 592–595. *Opopaea manderano,* n. sp., female. **592.** Carapace, anterior view. **593.** Lateral view. **594.** Dorsal view. **595.** Ventral view. Scale bars: 0.2 mm.

extension. Clypeus low, not rebordered. Chilum absent. Paturons proximal have bosses. Eyes large. ALE largest. ALE oval, PME squared, PLE circular; PME not darkened compared to other eyes, posterior eye row straight viewed from above, slightly procurved from front; ALE separated almost by their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface more or less punctuated, without pits, shape of posterior part short, rectangular, and not constricted. Area between coxae III with one U-shaped median protrusion (fig. 525); setae extremely abundant and evenly distributed, originating from surface, without hair tufts (figs. 522–533). Palp posterior margin with two large and smooth



Figs. 596–603. *Opopaea manderano,* n. sp. **596.** Male, palp, prolateral view. **597.** Retrolateral view. **598.** Leg IV, prolateral view. **599.** Retrolateral view. **600.** Male, palp, close up, prolateral view. **601.** Retrolateral view. **602.** Epigynum, ventral view. **603.** Dorsal view. Scale bars: figures 598, 599 = 0.2 mm; others = 0.1 mm.

distal and proximal protuberances. Palpal fenestra large and located at one third of the palp, enlarged posteriorly, fenestral top slightly raised, posterior margin heavily sclerotized, area before fenestra not raised, but also heavily sclerotized and extending toward the tip (figs. 510, 511, 526, 527, 530, 531, 534–544).

Female (allotype) (PBI_OON 28203). Total length 1.91. Dark brown orange, abdomen round and not flattened posteriorly. Postgynum depression short and more or less wide, with ridge not sclerotized (figs. 512, 532, 533).

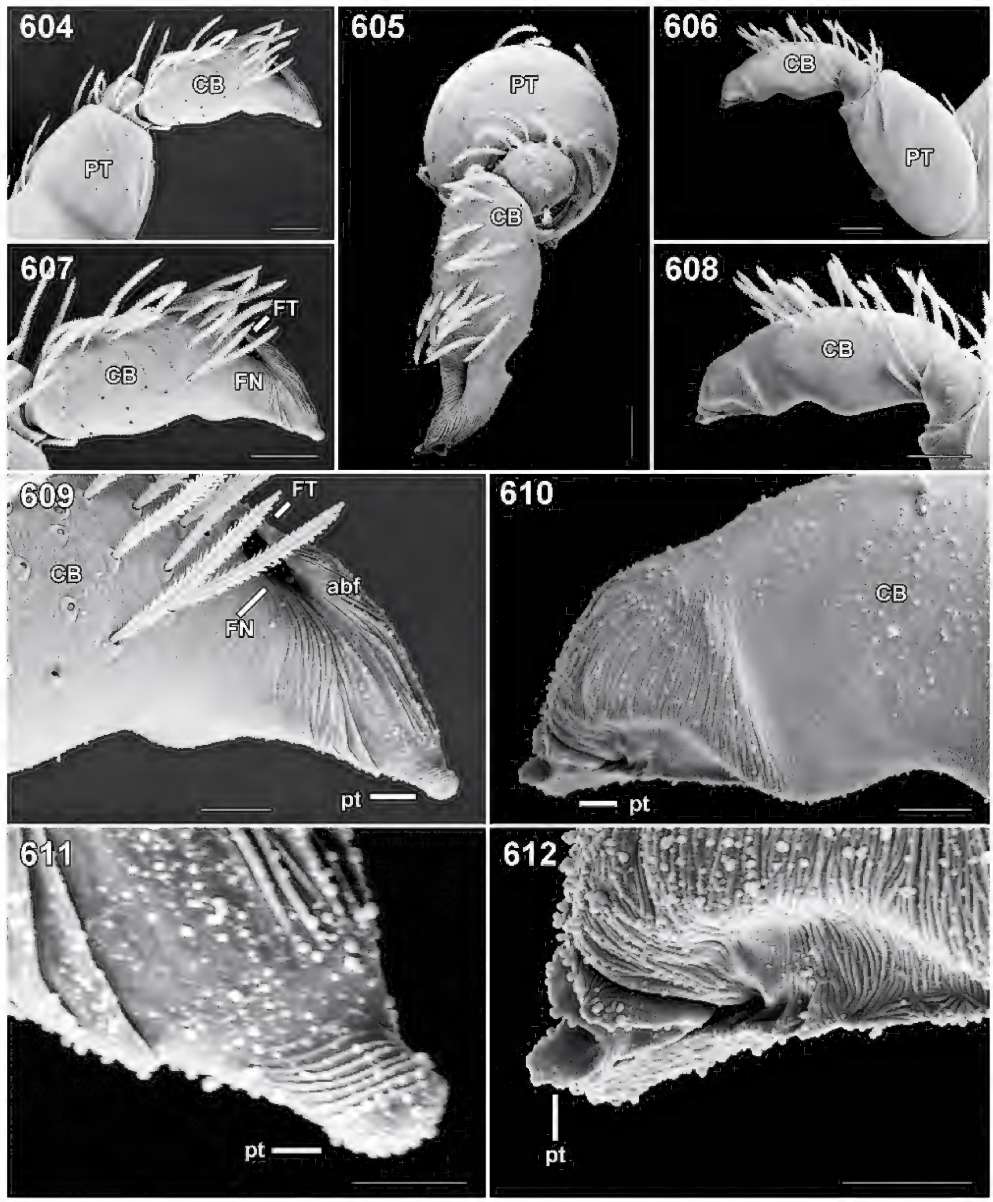
MEASUREMENT: Male (holotype) (PBI_OON 28203). TL: 1.96; CL: 0.81; CW: 0.67; CH: 0.36; AL: 1.18; AW: 0.93; ALE: 0.12; PME: 0.10; PLE: 0.09; EGW: 0.29; ALE-ALE: 0.03; ALE-PLE: 0.02; PME-PME: 0; PLE-PME: 0; CBL: 0.31; CBW: 0.12; CBL/PTL: 1.03; FI: 0.14.

Female (allotype) PBI_OON 28203). TL: 2.2; CL: 0.87; CW: 0.73; CH: 0.46; AL: 1.57; AW: 1.15; ALE: 0.11; PME: 0.10; PLE: 0.09; EGW: 0.29; ALE-ALE: 0.04; ALE-PLE: 0.03; PME-PME: 0; PLE-PME: 0; EFL: 0.25; LAL: 0.12; PGI (LAL/EFL): 0.44; PDL/LAL: 0.50; PDW/EFL: 0.64.

VARIATION: Male: TL: 1.90–1.99; CL: 0.81–0.83; CW: 0.67–0.68; AL: 1.11–1.29; AW: 0.91–0.93.

Female: TL: 2.17–2.20; CL: 0.85–0.87; CW: 0.71–0.73; AL: 1.33–1.57; AW: 1.04–1.15.

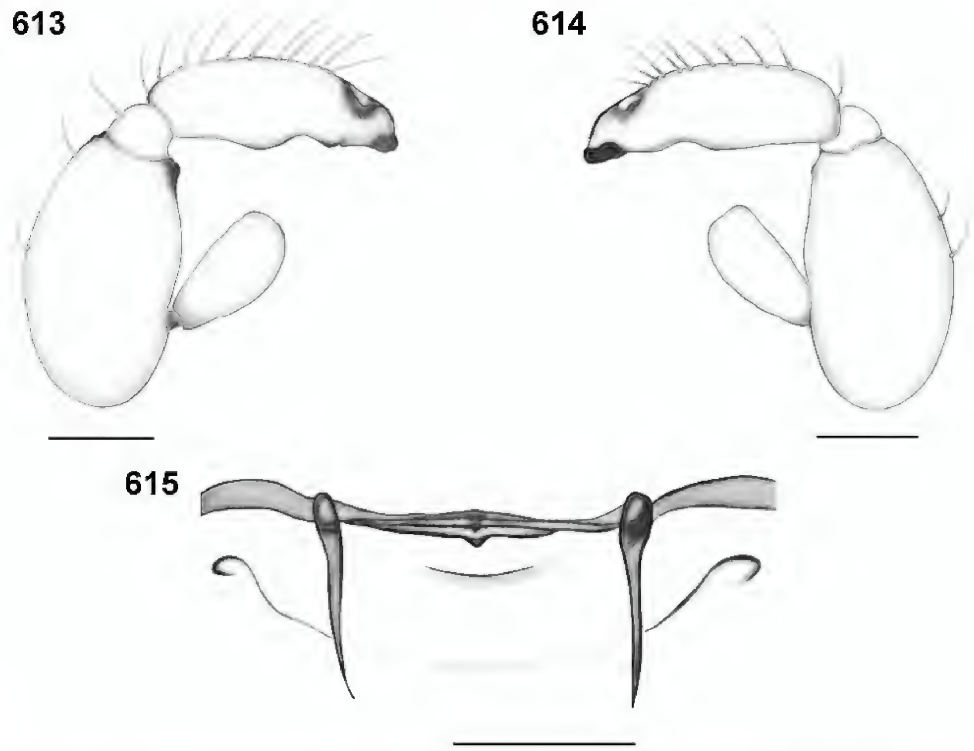
NATURAL HISTORY: *O. kirindy* was mostly found in tropical dry forest and primary tropical deciduous forest at low elevations (30–40 m).



Figs. 604–612. *Opopaea manderano,* n. sp., male palp. **604.** Prolateral view. **605.** Anterior view. **606.** Retrolateral view. **607, 609.** Close up, prolateral view. **608, 610.** Retrolateral view. **611.** Embolar region, prolateral view. **612.** Retrolateral view. Scale bars: figures 604–608 = 20 μm; figures 609, 610 = 10 μm; others = 5 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

DISTRIBUTION: *O. kirindy* was mostly found in southwestern Madagascar in the province of Toliara (Morondava, Kirindy) (map 1).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Toliara:** 48 km ENE Morondava, 20°04″S, 44°39″E, 30 m, general collecting, tropical dry, 04–10 January 1991, P.M Olson (MCZ PBI_OON 28204), 2♀. (MCZ PBI_OON 28203), 1♂. Kirindy forest station, 47 km NE Morondava, S20°04′14.7″, E44°39′44.7″, 40 m elevation, 06–08 February 2009, primary tropical deciduous forest, sifting leaf litter, C. Griswold, A. Saucedo, and H. Wood (CASC PBI_OON 35049), 1♂, 1♀.



Figs. 613–615. *Opopaea manongarivo,* n. sp. **613.** Male, palp prolateral view. **614.** Retrolateral view. **615.** Epigynum, dorsal view. Scale bars: 0.1 mm.

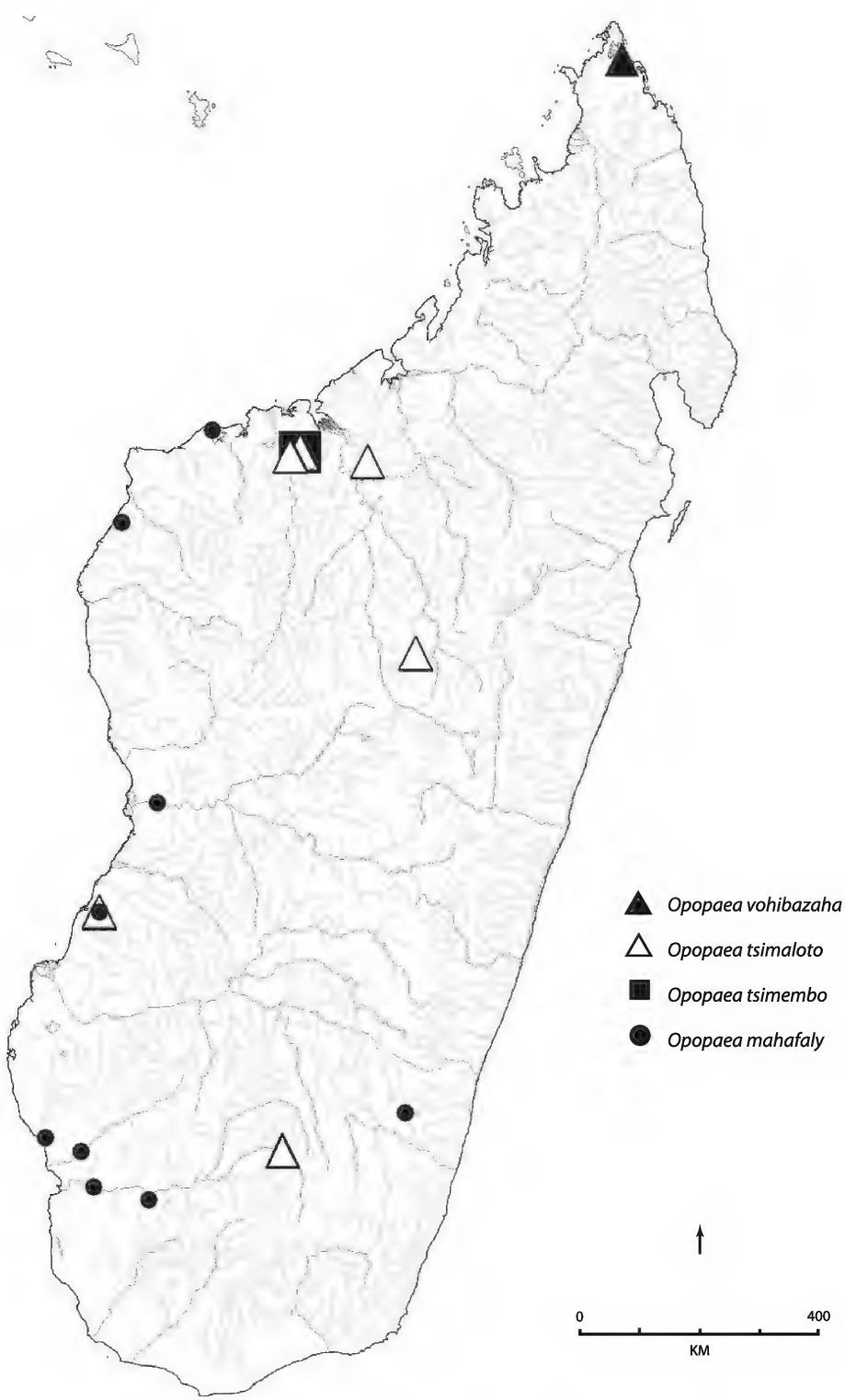
Opopaea mahafaly, new species
Figures 545–579; map 5

TYPES: Male holotype and female allotype from Toliara province: Réserve spéciale de Beza Mahafaly, 26 km ENE Betioky, 23°39′18.2″S, 44°37′58.8″E, 135 m, sifted litter, gallery forest, 23 April 1997, B.L. Fisher (CASC PBI_OON 34407).

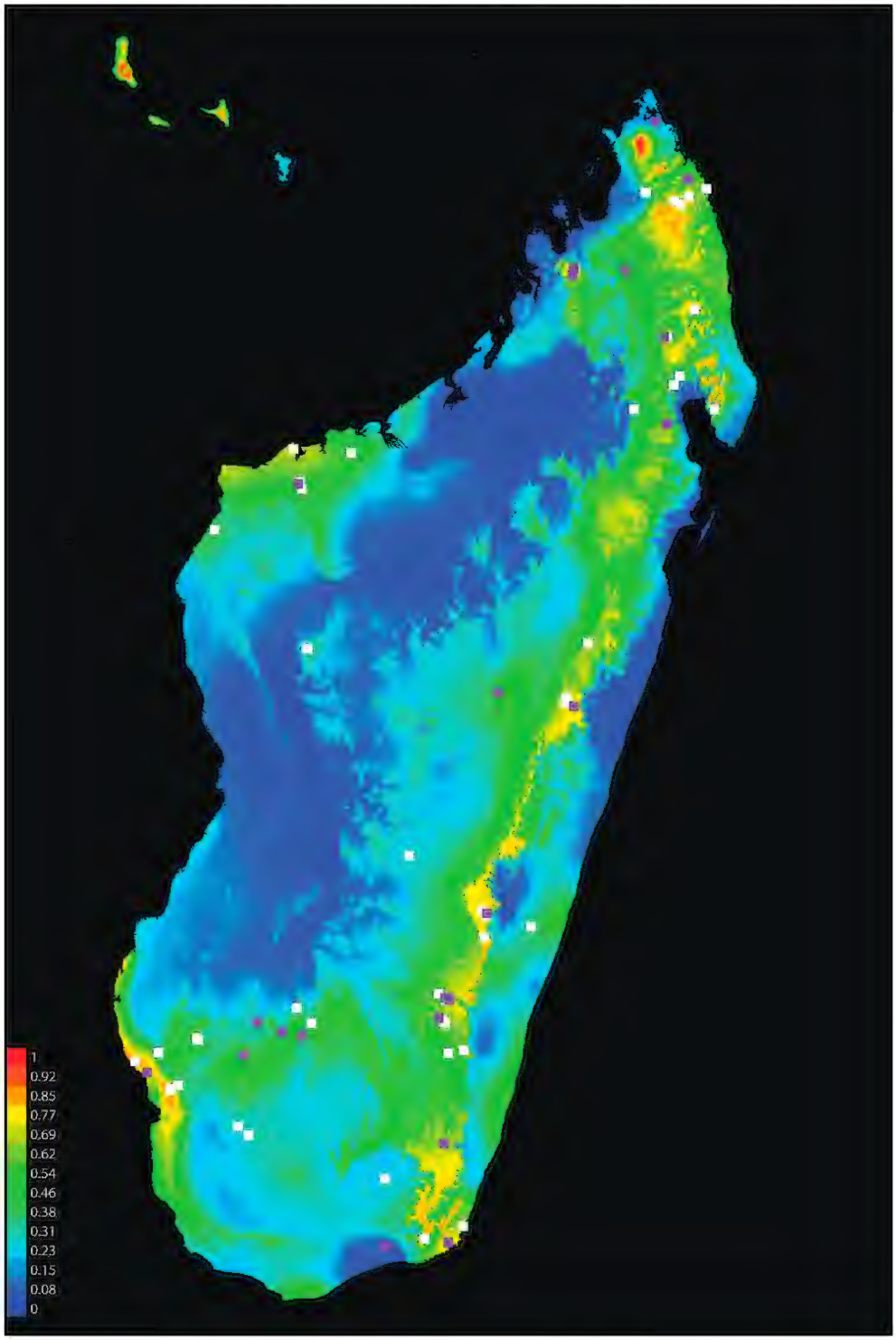
ETYMOLOGY: The species is named after the Malagasy tribe from the type locality.

DIAGNOSIS: Males of *O. mahafaly* resemble those of *O. bemaraha* in having a cymbiobulbus with a tip that opens into a small hole, but can be distinguished by the shape of the cymbiobulbus, which is flattened on prolateral side and with the upper part almost arclike (figs. 569–572) and a very simple, narrow tip that curves upward (fig. 577), instead of downward or on the lateral side like in *O. tsimbazaza* and *O. bemaraha*, respectively. Females of *O. mahafaly* resemble those of *O. andringitra* in having the scutal ridge thick and posteromedially drops down into a small reverse triangle shape, but can be differentiated by the undivided, unsclerotized scutal ridge and the shape and location of the small parmula, far above the epigastric furrow (figs. 547, 567, 568).

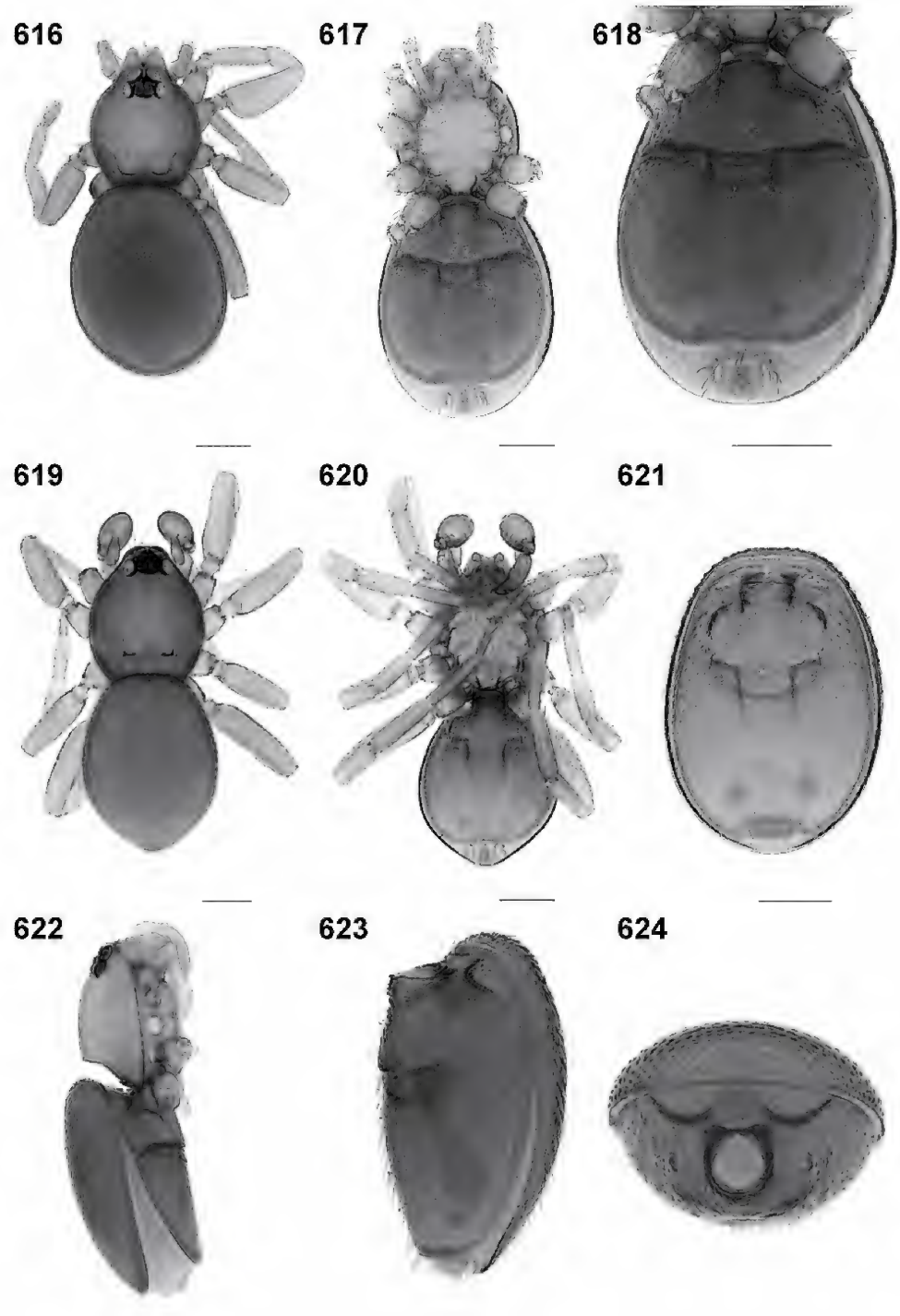
DESCRIPTION: Male (holotype) (PBI_OON 34407). Small to medium-sized species. Total length 1.32. Color: yellowish orange. Carapace: pars cephalica not elevated posteriorly with one row of two widely separated sets of two denticles (figs. 558, 559). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes large. ALE and PME largest. ALE oval, PME almost rectangular, PLE circular; PME darkened compared to other eyes, posterior eye row straight viewed from above, procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, shape of posterior part



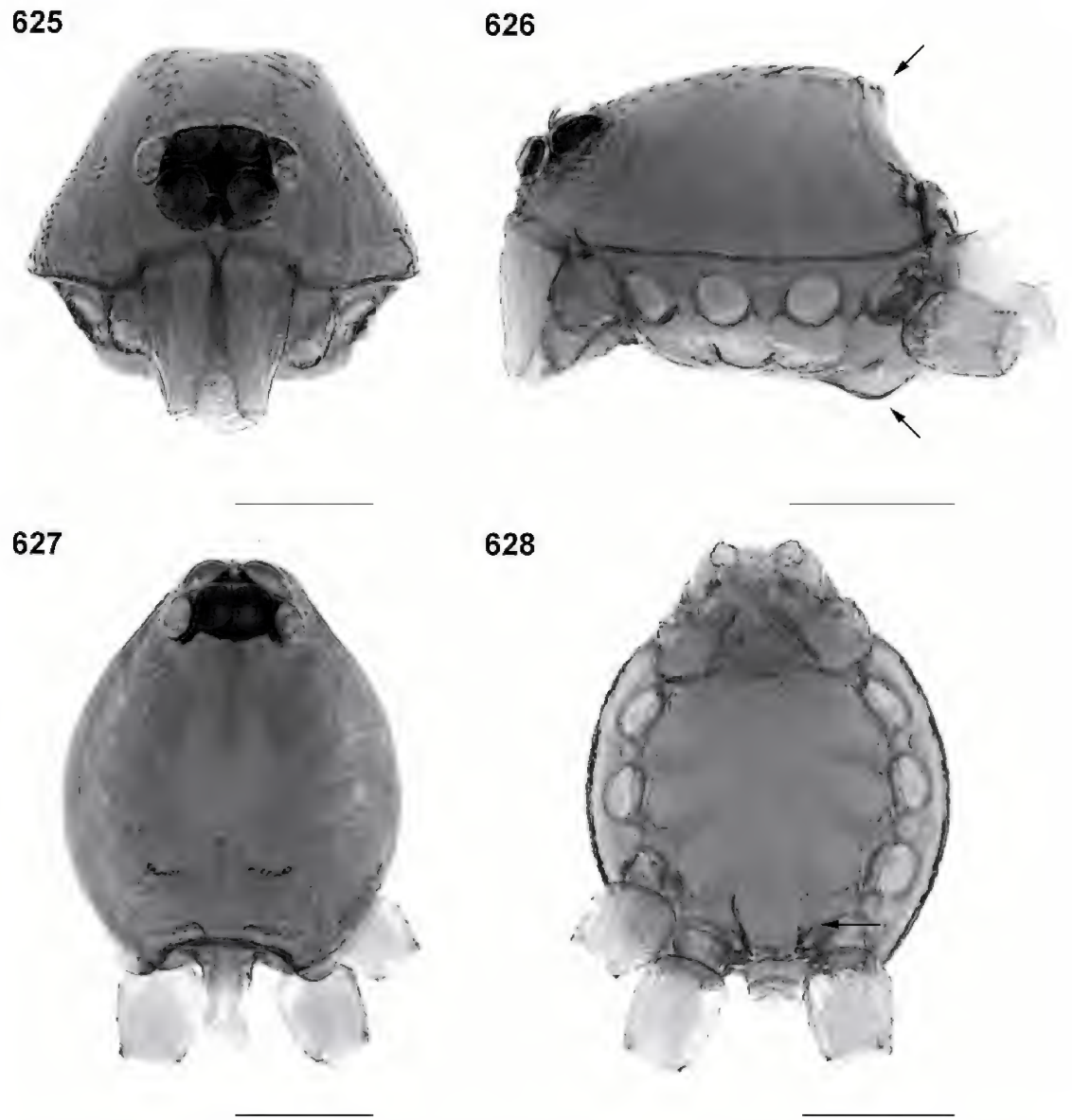
Map 5. Specimen records of *Opopaea* species in Madagascar: *Opopaea mahafaly, tsimaloto, tsimembo,* and *vohibazaha.*



Map 6. Predicted suitable areas for the genus *Opopaea* in Madagascar using all occurrence records, 19 bioclimatic variables, and elevation variable. Areas on the map classified from most suitable (1 or red) to least suitable (0 or blue).



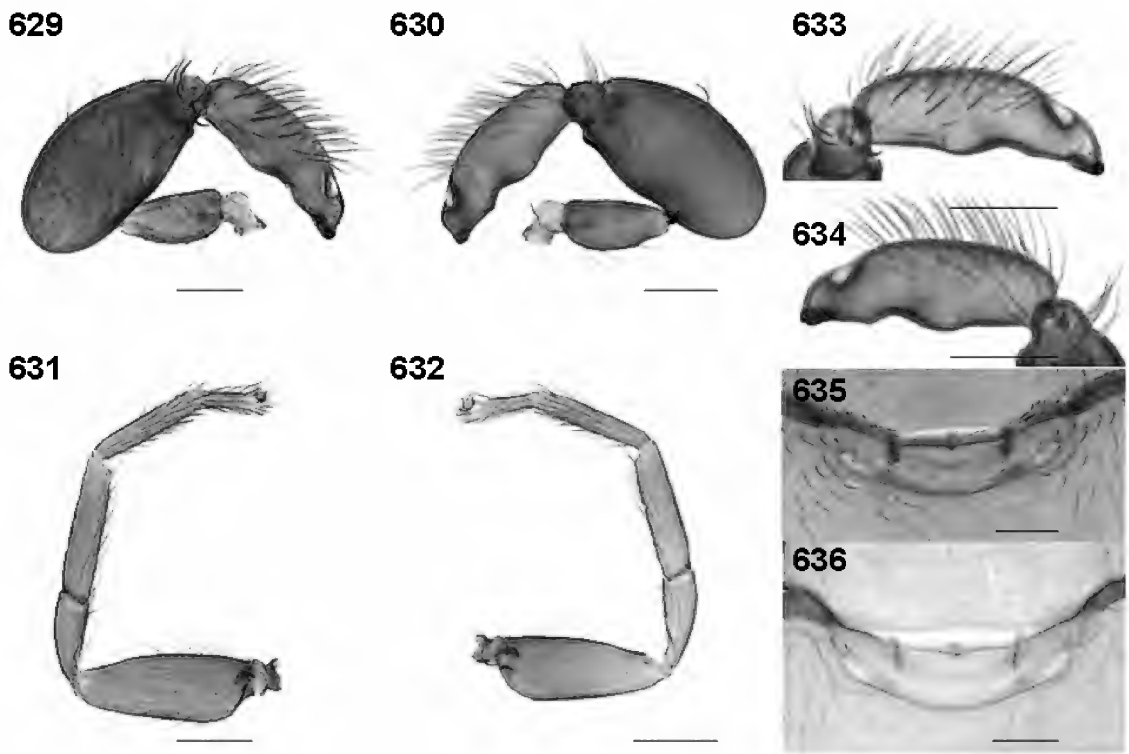
Figs. 616–624. *Opopaea manongarivo,* n. sp. **616.** Female, habitus, dorsal view. **617.** Habitus, ventral view. **618.** Abdomen, ventral view. **619.** Male, habitus, dorsal view. **620.** Habitus, ventral view. **621.** Abdomen, ventral view. **622.** Habitus, lateral view. **623.** Abdomen, lateral view. **624.** Anterior view. Scale bars: 0.2 mm.



Figs. 625–628. *Opopaea manongarivo,* n. sp., male. **625.** Carapace, anterior view. **626.** Lateral view. **627.** Dorsal view. **628.** Ventral view. Scale bars: 0.2 mm.

between coxae IV hexagonal not constricted. Lateral margins of area between coxae III unmodified, without lumps; setae sparse, densest at margins, originating from surface, without hair tufts (figs. 557–560). Male palp cymbiobulbus almost same length as patella, posterior margin with two protuberances: a smooth and large proximal one and one small and pointed distal one, tip with a short sclerotized liplike extension that curves upward. Palpal femora one third the length of palpal patella and inserted almost medially to it, patella thick. Fenestra thin and elongated located at one third of the palp, fenestra anterior top flattened, slightly sclerotized and sloping downward toward the tip (figs. 545, 546, 561, 562, 565, 566, 569–579).

Female (allotype) (PBI_OON 34407). Total length 1.64. Yellowish orange, abdomen round and flattened posteriorly. Postgynum



Figs. 629–636. *Opopaea manongarivo,* n. sp. **629.** Male, palp, prolateral view. **630.** Retrolateral view. **631.** Leg IV, prolateral view. **632.** Retrolateral view. **633.** Close up, prolateral view. **634.** Retrolateral view. **635.** Epigynum, ventral view. **636.** Dorsal view. Scale bars: figures 631, 632 = 0.2 mm; others = 0.1 mm.

depression ridge thin, not sclerotized (figs. 547, 567, 568).

MEASUREMENTS: Male (holotype) (PBI_OON 34407). TL: 1.32; CL: 0.59; CW: 0.47; CH: 0.27; AL: 0.78; AW: 0.51; ALE: 0.08; PME: 0.07; PLE: 0.06; EGW: 0.20; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; CBL: 0.19; CBW: 0.08; CBL/PTL: 0.82; FI: 0.11.

Female (allotype) (PBI_OON 34407). TL: 1.64; CL: 0.67; CW: 0.54; CH: 0.31; AL: 1.04; AW: 0.71; ALE: 0.09; PME: 0.08; PLE: 0.06; EGW: 0.20; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.01; EFL: 0.14; LAL: 0.06; PGI (LAL/EFL): 0.43; PDL/LAL: 0.5; PDW/EFL: 0.28.

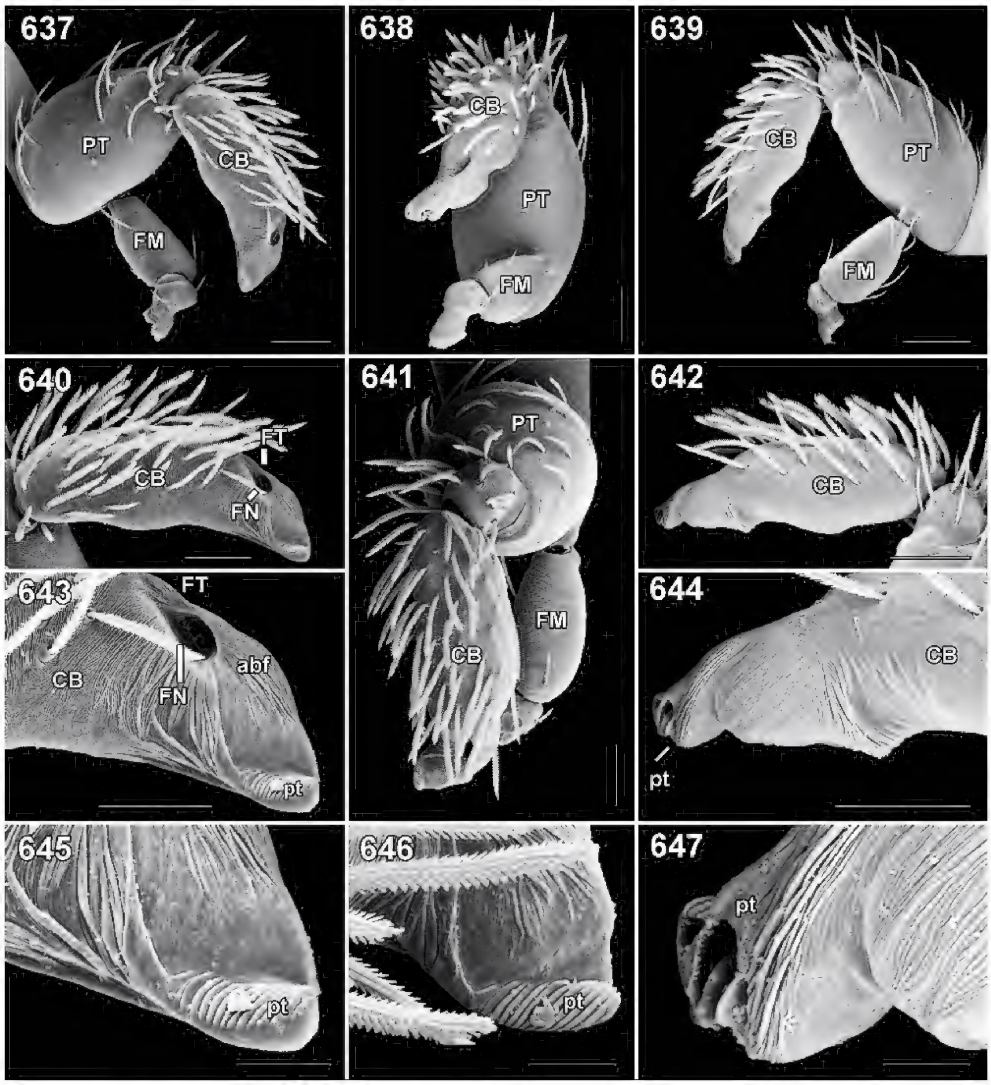
VARIATION: Male: TL: 1.32–1.38; CL: 0.59–0.62; CW: 0.47–0.54; AL: 0.78–0.81; AW: 0.51–0.56.

Female: TL: 1.64–1.64; CL: 0.66–0.67; CW: 0.52–0.54; AL: 0.98–1.04; AW: 0.70–0.71.

NATURAL HISTORY: *O. mahafaly* was mostly found in tropical dry forest, gallery forest, and spiny forest from 30–600 m elevations.

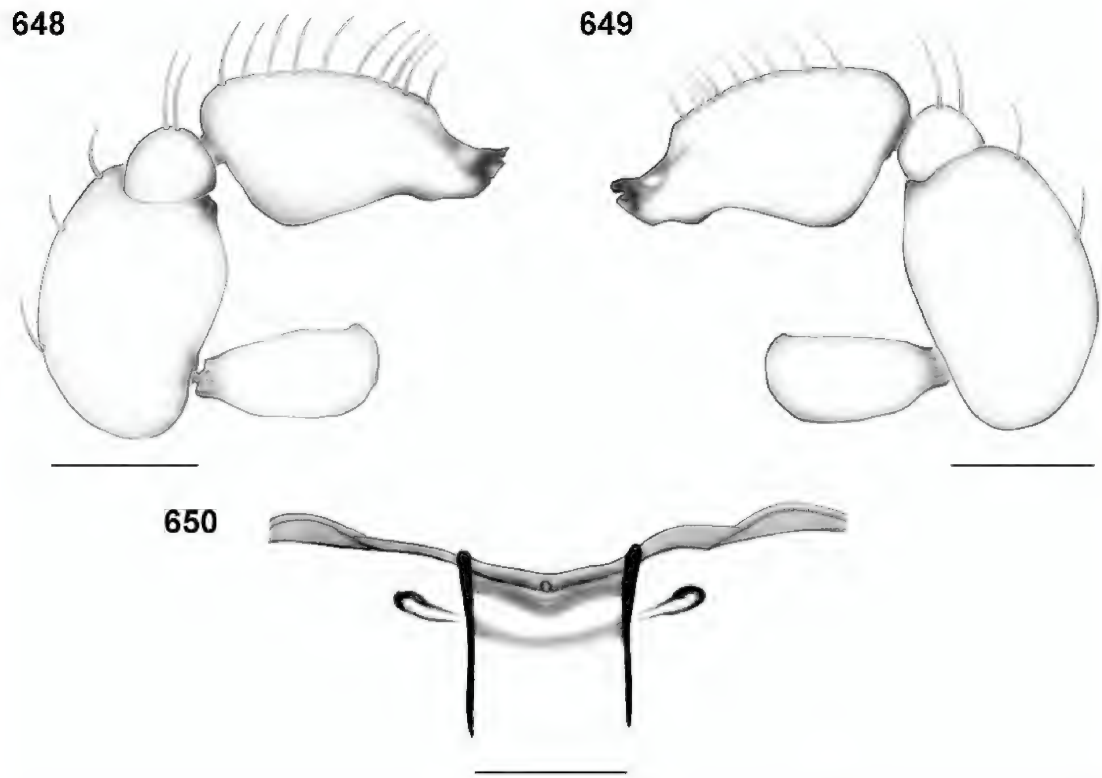
DISTRIBUTION: *O. mahafaly* was mostly found in the south, southwestern, and south-central regions of Madagascar in the provinces of Toliara, Mahajanga, and Fianarantsoa (Beza Mahafaly, Kirindy Mite, Ranobe, Antafoky, Manderano, Fiherenana, Tsingy de Bemaraha, Bemarivo, Vevembe) (map 5).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Toliara**: Réserve spéciale Beza Mahafaly, 26 km ENE Betioky, 23°39′18.2″S, 44°37′58.8″E, 147 m, general collecting day and night, gallery forest, 17–20 January 2009, coll. Fisher et al., Frontier Project (CASC PBI_OON 35102), 2♀. 135 m, sifted litter, gallery forest, 23 April 1997, B.L. Fisher (CASC PBI_OON 34407), 44♂, 45♀. Pitfalls, 18 January 2009, D. Andriamalala, C. Griswold, G. Hormiga, A. Saucedo, N. Scharff, and H. Wood. (AMNH PBI_OON 35229), 1♂, 1♀. Park National Kirindy Mite, 16.3 km 127° SE Belo sur mer, 20°47′43″S, 44°8′49″E,



Figs. 637–647. *Opopaea manongarivo,* n. sp., male palp. **637.** Prolateral view. **638, 641.** Ventral view. 639. Retrolateral view. **640, 643.** Close up, prolateral view. **642, 644.** Retrolateral view. **645.** Embolar region, prolateral view. **646.** Anteroprolateral view. **647.** Retrolateral view. Scale bars: figures 637–639, 641 = 20 μm; figures 640, 642, 645, 646 = 10 μm; figure 647 = 6 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

80 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 06–10 December 2001, coll. B.L. Fisher et al. (CASC PBI_OON 3116), 3♂, 5♀. Ranobe, 23°02′22″S, 43°36′37″E, 30 m, EH11 sifted litter (leaf mold, rotten wood), spiny forest/thicket, 05–28 January 2003, coll. Fisher et al., Frontier Project (CASC PBI_OON 35042), 2♀. Antafoky, 23°28′45″S, 44°3′58″E, 60 m, leaf litter extraction, gallery forest, 21 January 2002, coll. Frontier Project (CASC PBI_OON 3832), 18♂, 36♀. Manderano, 23°10′37″S, 43°57′39″E, 100 m, EF19 sifted litter (leaf mold, rotten wood), gallery forest, 03–07 Nov 2002, coll. Fisher et al., Frontier Project (CASC PBI_OON 3118), 1♀. Fiherenana, 23.52722°S, 44.0875°E, 70 m, leaf litter extraction, gallery forest, 27 January 2006, coll. Frontier Project (CASC PBI_OON 34404), 10♀. **Mahajanga**: Park National Tsingy de Bemaraha, 10.6 km



Figs. 648–650. *Opopaea maroantsetra,* n. sp. **648.** Palp prolateral view. **649.** Retrolateral view. **650.** Epigynum, dorsal view. Scale bars: 0.1 mm.

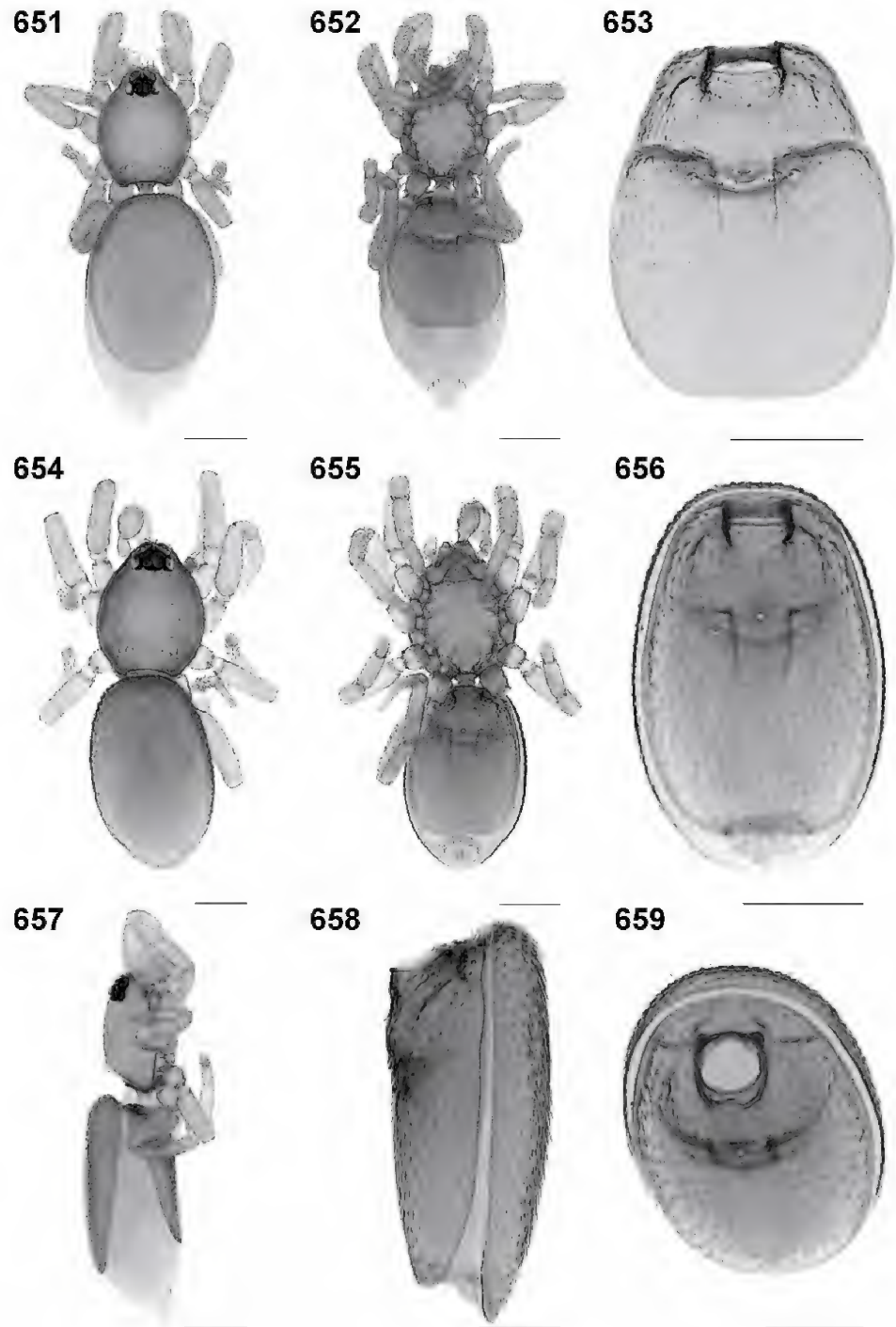
ESE 123° Antsalova, 19°42′34″S, 44°43′5″E, 150 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest on Tsingy, 16–20 November 2001, coll. B.L. Fisher et al. (CASC PBI_OON 35051), 12♂, 18♀. Park National de Baie Baly, 12.4 km 337° NNW Soalala, 16°00′36″S, 45°15′54″E, 10 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 26–30 November 2002, C. Griswold and B. Fisher, et al. (CASC PBI_OON 34399), 2♂, 6♀. Réserve spécial de Bemarivo, 23.8 km 223° SW Besalampy, 16°55′30″S, 44°22′06″E, 30 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 19–23 May 2002, coll. B.L. Fisher and Griswold et al. (CASC PBI_OON 3778), 6♂, 19♀. **Fianarantsoa**: Forêt de Vevembe, 66.6 km 293° WNW Farafangana, 22°47′28″S, 47°10′55″E, 600 m, winkler, tropical dry forest, 23 April 2006, coll. B.L. Fisher et al. (CASC PBI_OON 34410), 2♀.

Opopaea manderano, new species
Figures 5, 27, 48, 580–612; map 3

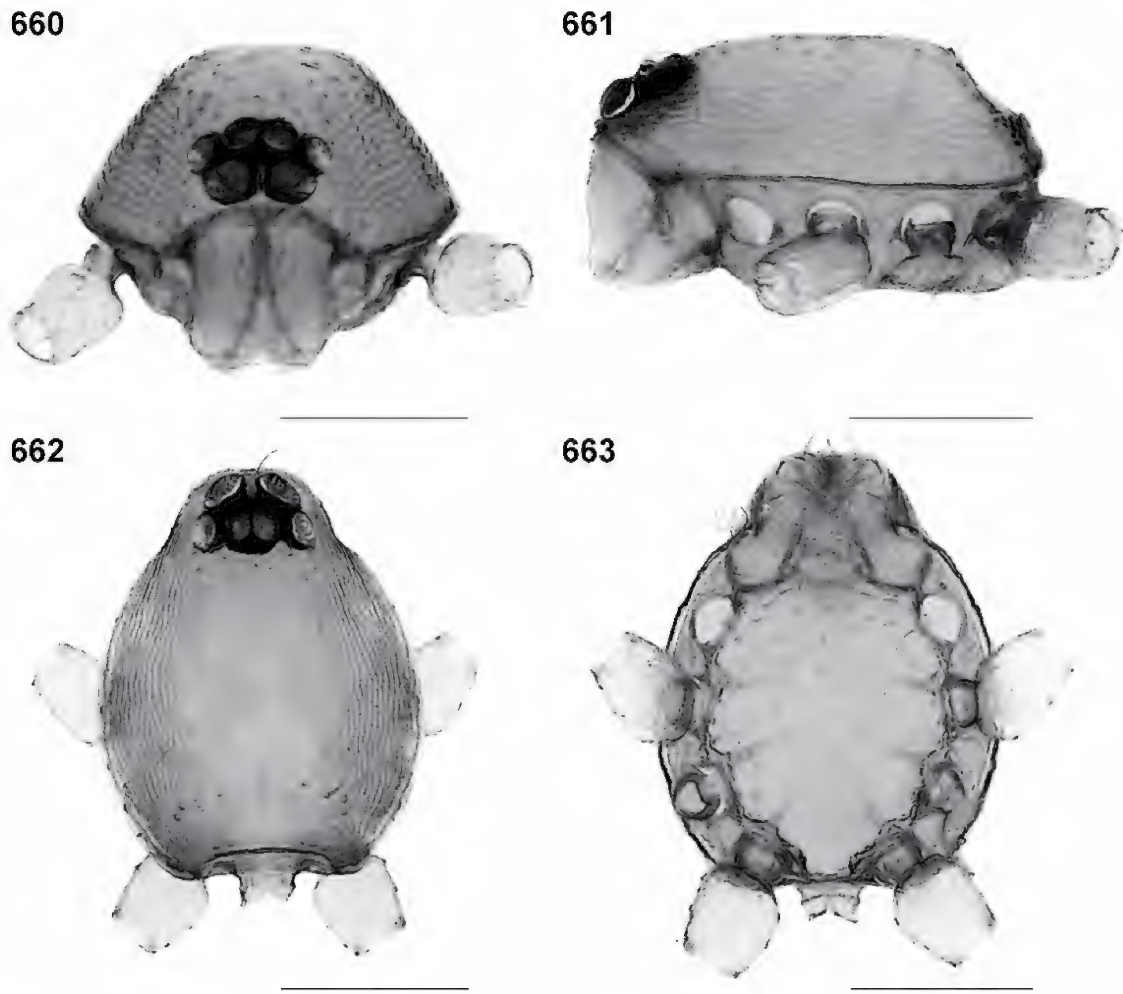
TYPES: Male holotype and female allotype from Toliara: Park National Zombitse, 19.8 km 84° E Sakaraha, 22°05′36″S, 44°42′36″E, 770 m, EF19 sifted litter (leaf mold, rotten wood), gallery forest, 05–09 February 2003, C. Griswold and B. Fisher, et al. (CASC PBI_OON 3818). Manderano, 23°31′38″S, 44°05′15″E, 70 m, ER19 sifted litter (leaf mold, rotten wood), gallery forest, 10 May 2002, coll. Frontier Project (CASC PBI_OON 3883), 7♀ paratypes.

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. manderano* can most easily be distinguished from those of other *Opopaea* species in particular by the cymbiobulbus that tapers anteriorly and has a tip that terminates in a long, thin,



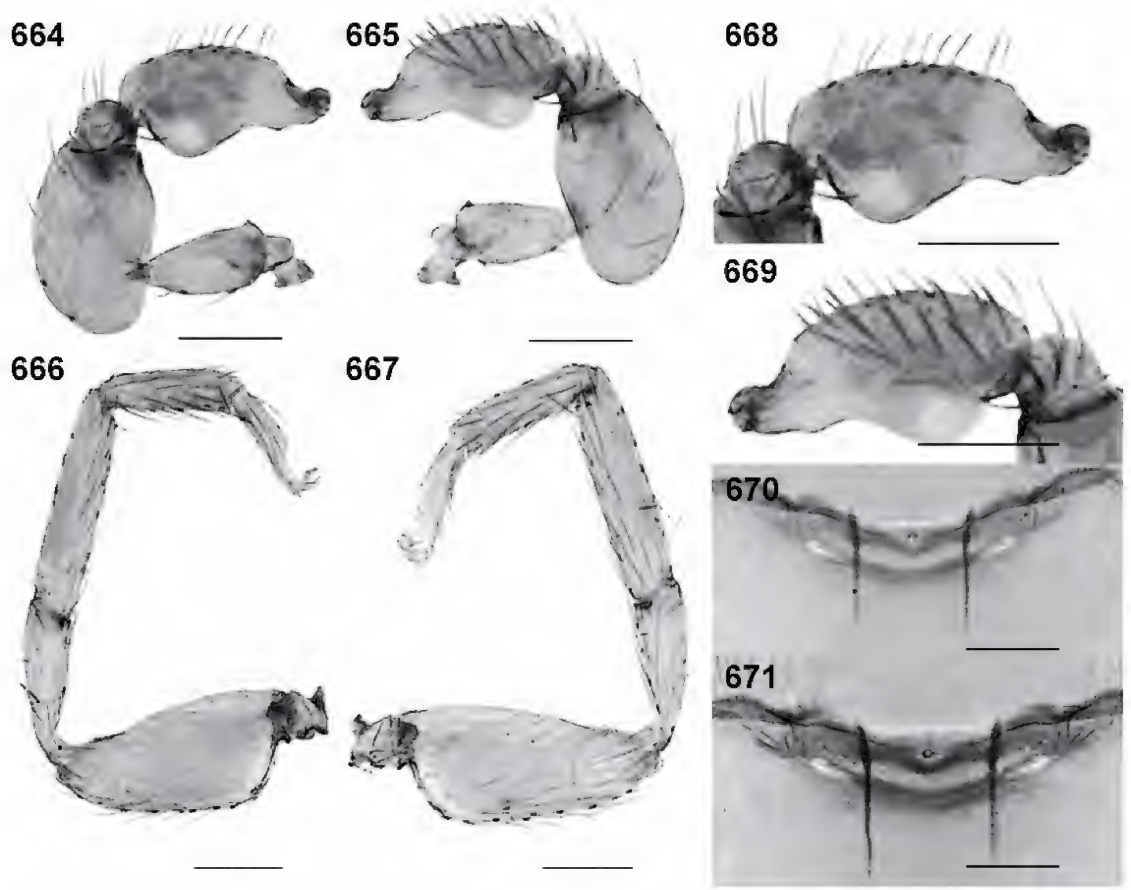
Figs. 651–659. *Opopaea maroantsetra,* n. sp. **651.** Female, habitus, dorsal view. **652.** Habitus, ventral view. **653.** Abdomen, ventral view. **654.** Male, habitus, dorsal view. **655.** Habitus, ventral view. **656.** Abdomen, ventral view. **657.** Habitus, lateral view. **658.** Abdomen, lateral view. **659.** Anterior view. Scale bars: 0.2 mm.



Figs. 660–663. *Opopaea maroantsetra,* n. sp., female. **660.** Carapace, anterior view. **661.** Lateral view. **662.** Dorsal view. **663.** Ventral view. Scale bars: 0.2 mm.

sclerotized extension, which points forward (figs. 596, 597, 600, 601). Females of *O. manderano* can easily be recognized by a short and narrow U-shaped postgynum depression, which is interrupted medially, and a scutal ridge that bears two parmulae, one on top of the other in its median part: a large and triangular one below, and a round and small one above (figs. 582, 602, 603).

DESCRIPTION: Male (holotype) (PBI_OON 3883). Medium-sized species. Total length 1.49. Color: orange to yellowish orange. Carapace: pars cephalica not elevated posteriorly with one row of two sets of three denticles, carapace anteriorly narrowed to about one third its maximum width. Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes medium sized. ALE largest. ALE oval, PME squared and PLE circular; PME darkened compared to other eyes, posterior eye row straight viewed from above, procurved from front; ALE separated by their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth and shiny, without pits, posterior part more or less wide and more or less triangular toward posterior edge. Lateral margins between



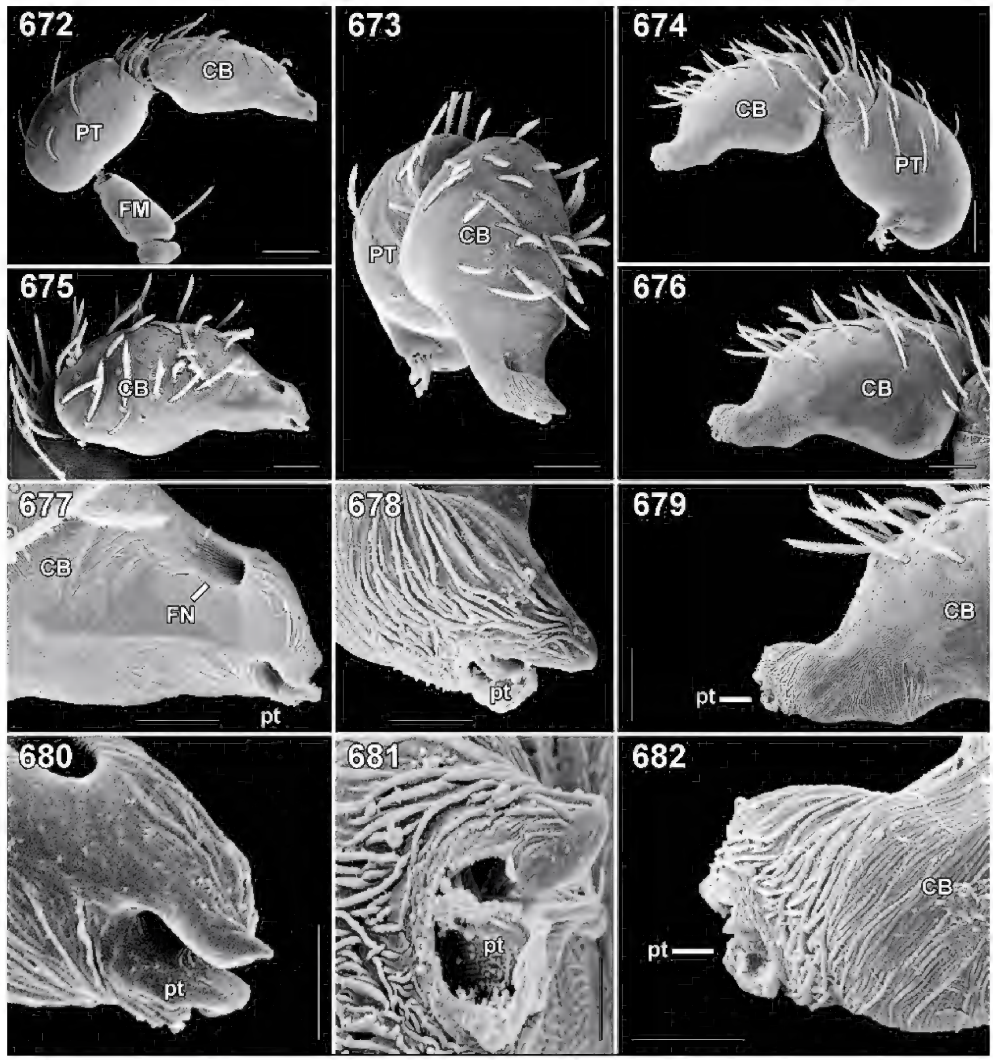
Figs. 664–671. *Opopaea maroantsetra,* n. sp. **664.** Male, palp, prolateral view. **665.** Retrolateral view. **666.** Leg IV, prolateral view. **667.** Retrolateral view. **668.** Male, palp, close up, prolateral view. **669.** Retrolateral view. **670.** Epigynum, ventral view. **671.** Dorsal view. Scale bars: figures 666, 667 = 0.2 mm; others = 0.1 mm.

coxae III unmodified, without lumps; setae sparse, dark, needlelike, densest laterally, originating from surface, without hair tufts (figs. 618–621). Palp posterior margin with two protuberances, a large proximal one and a small more or less sharp distal one. Palpal fenestra small and elliptic, located at one third the length of the palp, fenestral top thin, sclerotized, rising slightly toward tip (figs. 139, 140, 622, 623, 626, 627, 630–638).

Female (paratype from Manderano) (PBI_OON 3883). Total length 1.61. As in male but larger, color orange, abdomen oval, and not flattened toward posterior end, ventral scutum more or less rectangular. Postgynum depression lateral edges more or less thick internally. Scutal ridge thin, sclerotized, and divided (figs. 582, 602, 603).

MEASUREMENTS: Male (holotype) (PBI_OON 3818). TL: 1.49; CL: 0.66; CW: 0.53; CH: 0.27; AL: 0.88; AW: 0.61; ALE: 0.09; PME: 0.1; PLE: 0.08; EGW: 0.22; ALE-ALE: 0.02; ALE-PLE: 0; PME-PME: 0; PLE-PME: 0; CBL: 0.21; CBW: 0.09; CBL/PTL: 0.80; FI: 0.12.

Female (paratype from Manderano) (PBI_OON 3883). TL: 1.61; CL: 0.60; CW: 0.50; CH: 0.24; AL: 1.03; AW: 0.68; ALE: 0.07; PME: 0.06; PLE: 0.06; EGW: 0.19; ALE-ALE: 0.04; ALE-PLE: 0; PME-PME: 0; PLE-PME: 0; EFL: 0.15; LAL: 0.08; PGI (LAL/EFL): 0.53; PDL/LAL: 0.62; PDW/EFL: 0.53.



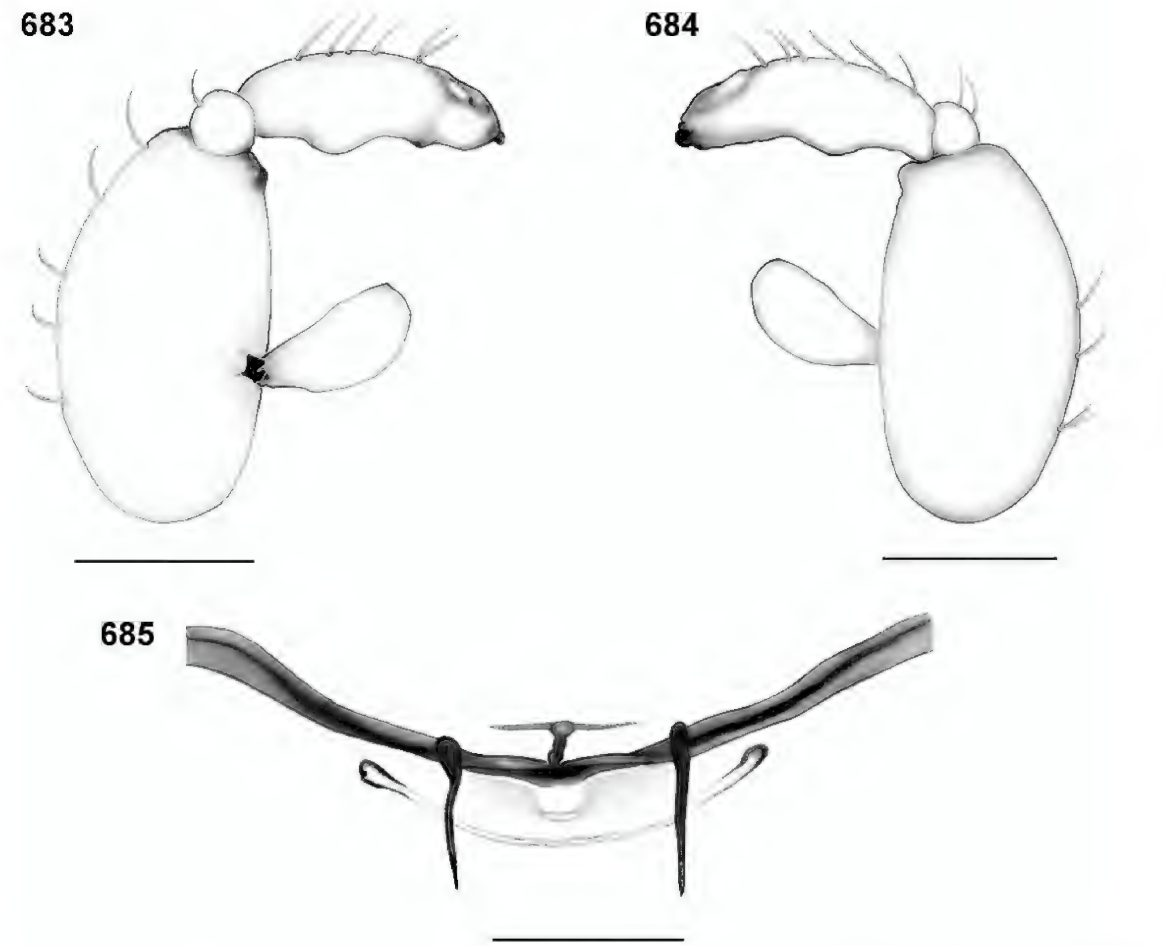
Figs. 672–682. *Opopaea maroantsetra,* n. sp., male palp. **672.** Prolateral view. **673.** Anterior view. **674.** Retrolateral view. **675, 677.** Close up, prolateral view. **676, 679.** Retrolateral view. **678, 681.** Embolar region, anterior view. **680.** Prolateral view. **682.** Retrolateral view. Scale bars: figures 672–674 = 30 μm; figure 676 = 20 μm; figures 677, 678 = 8 μm; others = 6 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FN,** fenestra; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

VARIATION: Female: TL: 1.61–1.67; CL: 0.60–0.63; CW: 0.50–0.50; AL: 0.98–1.04; AW: 0.68–0.69.

NATURAL HISTORY: *O. manderano* was mostly found in gallery forest from 70–770 m elevations.

DISTRIBUTION: *O. manderano* was mostly found in southern Madagascar in the province of Toliara (Manderano, Beza Mahafaly, Zombitse) (map 3).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Toliara:** Manderano, 23.52417°S, 44.09278°E, 75 m, ER19 sifted litter (leaf mold, rotten wood), gallery forest, 30 May 2006, Frontier Project (CASC PBI_OON 35099), 7♀ (CASC PBI_OON 34402), 4♀. Réserve spéciale de Beza Mahafaly, 26 km ENE Betioky, 23°39′18.2″S, 44°37′58.8″E, 147 m, sifting leaf litter, gallery forest, 17–20 January 2009, C. Griswold, A. Saucedo



Figs. 683–685. *Opopaea namoroka,* n. sp. **683.** Male, palp, prolateral view. **684.** Retrolateral view. **685.** Epigynum, dorsal view. Scale bars: 0.1 mm.

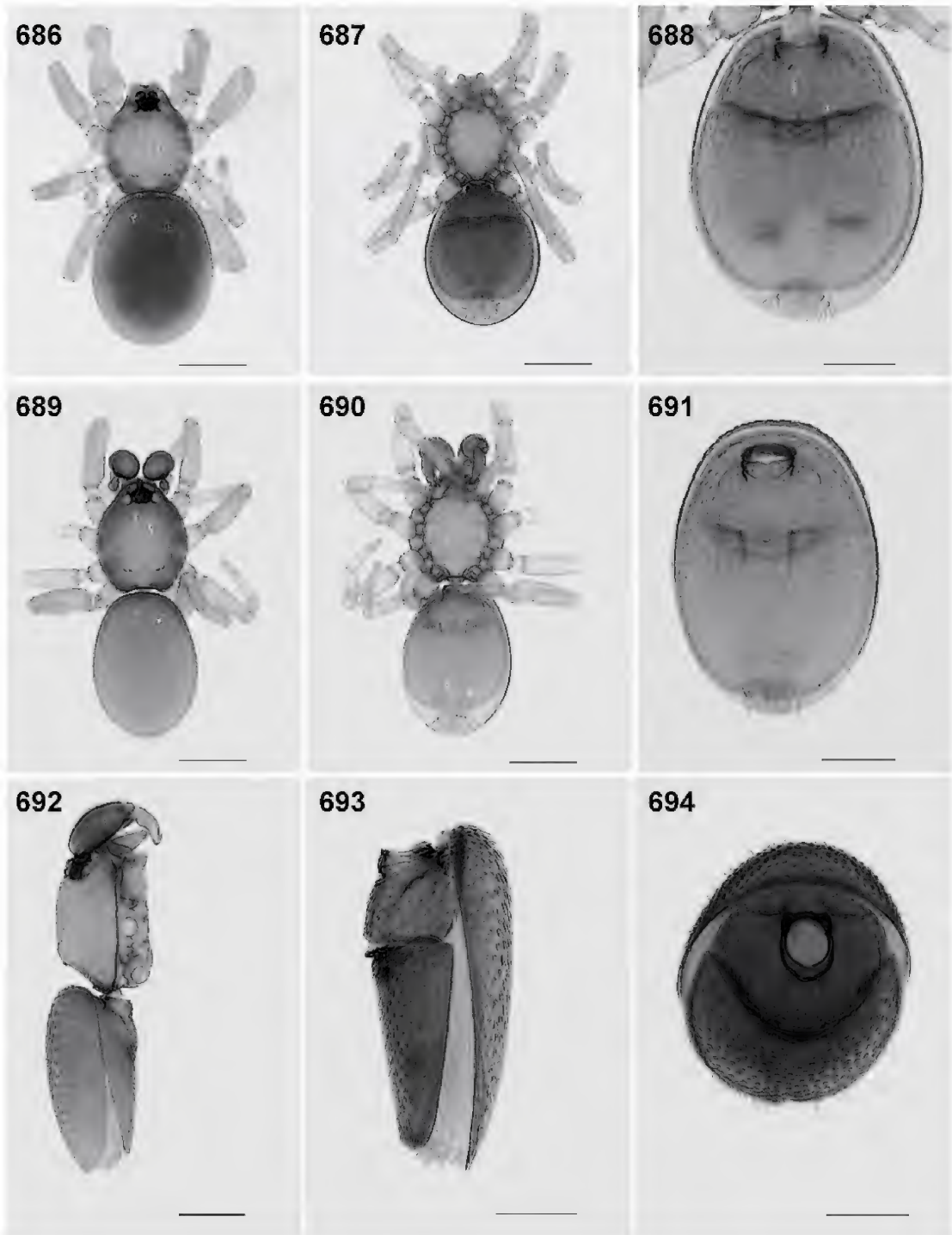
and H. Wood (CASC PBI_OON 3510), 2♀. Park National Zombitse, 19.8 km 84° E Sakaraha, 22°05′36″S, 44°42′36″E, 770 m, EF19 sifted litter (leaf mold, rotten wood), gallery forest, 05–09 February 2003, C. Griswold and B. Fisher, et al. (CASC PBI_OON 3818), 3♀.

Opopaea manongarivo, new species
Figures 613–647; map 2

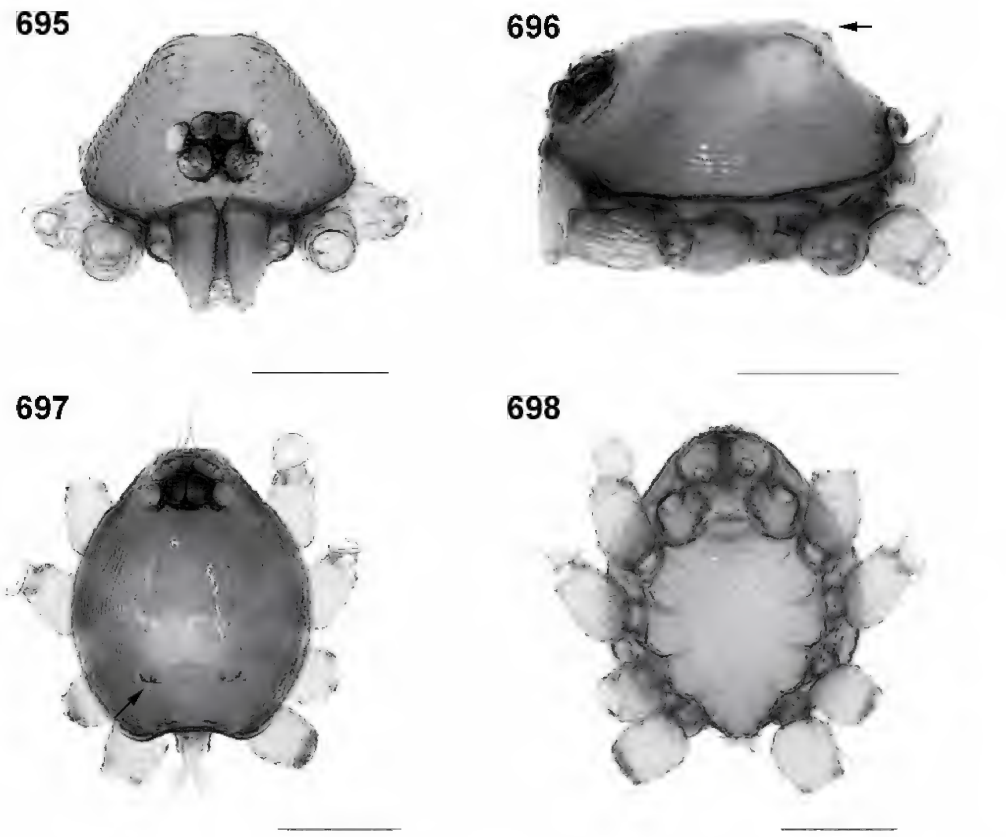
TYPES: Male holotype and female allotype from Antsiranana: Réserve spéciale de Manongarivo, 12.8 km 228° SW Antanambao, 13°58.6′S, 48°25.4′E, 780 m, sifted litter, montane rainforest, 11 October 1998, coll. B.L. Fisher (CASC PBI_OON 3847).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. manongarivo* can be most easily distinguished from those of other *Opopaea* species by having a palpal anterior part round, bearing a more or less long, sclerotized embolic extension that folds laterally on the retrolateral side (figs. 613, 629–633, 643, 645, 646). Females of *O. manongarivo* can be distinguished by having the line uniting the tracheal spiracles sclerotized and the divided parmula with the higher part of the parmula smaller (about 0. 07 mm) and the lower part triangular, larger, and hanging below the lower margin of the scutal ridge measuring about 0.19 mm (figs. 615, 635, 636).



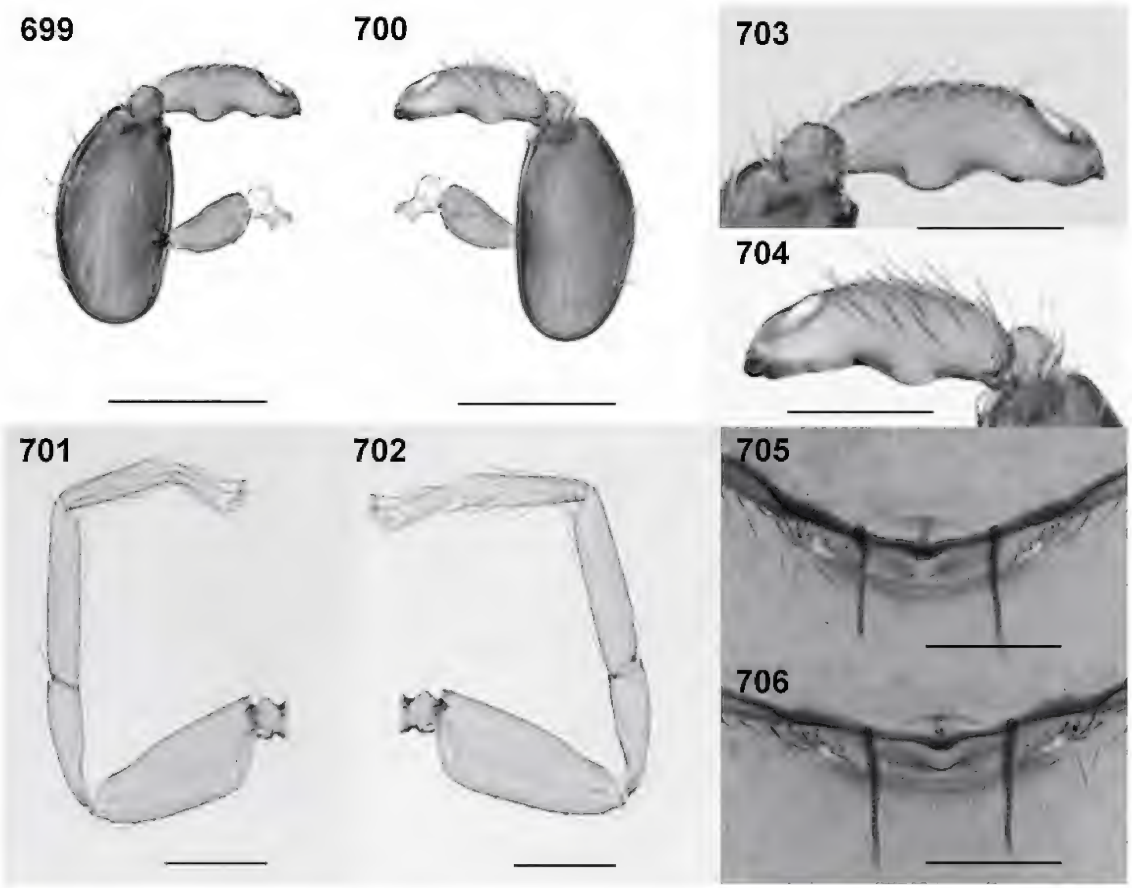
Figs. 686–694. *Opopaea namoroka,* n. sp. **686.** Female, habitus, dorsal view. **687.** Habitus, ventral view. **688.** Abdomen, ventral view. **689.** Male, habitus, dorsal view. **690.** Ventral view. **691.** Abdomen, ventral view. **692.** Habitus, lateral view. **693.** Abdomen, lateral view. **694.** Anterior view. Scale bars: 0.2 mm.



Figs. 695–698. *Opopaea namoroka,* n. sp., male. **695.** Carapace, anterior view. **696.** Lateral view. **697.** Dorsal view. **698.** Ventral view. Scale bars: 0.2 mm.

DESCRIPTION: Male (holotype) (PBI_OON 3847). Small to medium-sized species. Total length 1.45. Color: body orange; legs, palp, and patella yellow. Carapace: pars cephalica elevated, with one row of two widely separated sets of two sharp lateral denticles raised into pointed humps (figs. 626, 627), anteriorly narrowed to two thirds its maximum width. Carapace anterolateral corners without sclerotized, triangular extension. Clypeus low, not rebordered. Chilum present, undivided. Eyes very large. ALE largest. ALE, PME, and PLE oval; PME darkened compared to other eyes, posterior eye row straight viewed from above and from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, microsculptures only in furrows, shape of posterior part between coxae IV rectangular and swollen (fig. 628). Lateral margins of area between coxae III unmodified, without lumps; setae sparse, dark, needlelike, densest laterally, originating from surface, without hair tufts (figs. 625–628). Palp cymbiobulbus slightly curved downward, with one posteromedian protuberance. Palpal fenestra large, more or less circular, enlarged anteriorly and located at one third of the palp. Fenestral top flat. Cymbiobulbus almost of the same length and color as patella. Femur longer, inserted at about one third the length from the posterior end of patella (figs. 613, 614, 629, 630, 633, 634, 637–647).

Female (allotype) (PBI_OON 3847). Total length 1.74. Abdomen round and not flattened laterally toward posterior end. Postgynum depression as wide as the distance



Figs. 699–706. *Opopaea namoroka,* n. sp. **699.** Male, palp, prolateral view. **700.** Retrolateral view. **701.** Leg IV, prolateral view. **702.** Leg IV, retrolateral view. **703.** Male, palp, close up, prolateral view. **704.** Retrolateral view. **705.** Epigynum, ventral view. **706.** Dorsal view. Scale bars: figures 701, 702 = 0.2 mm; others = 0.1 mm.

between the two lateral apodemes and as long as one third the distance separating the epigynal furrow and the line uniting the tracheal spiracles. Line uniting the tracheal spiracles sclerotized postgynum ridge thinner and barely sclerotized medially (figs. 615, 635, 636).

MEASUREMENTS: Male (holotype) (PBI_OON 3847). TL: 1.45; CL: 0.68; CW: 0.55; CH: 0.31; AL: 0.90; AW: 0.62; ALE: 0.09; PME: 0.09; PLE: 0.08; EGW: 0.24; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; CBL: 0.26; CBW: 0.09; CBL/PTL: 1; FI: 0.11.

Female (PBI_OON 3717). TL: 1.74; CL: 0.70; CW: 0.60; AL: 1.06; AW: 0.87; EFL: 0.21; LAL: 0.10; PGI: 0.47; PDL/LAL: 0.50; PDW/EFL: 0.57.

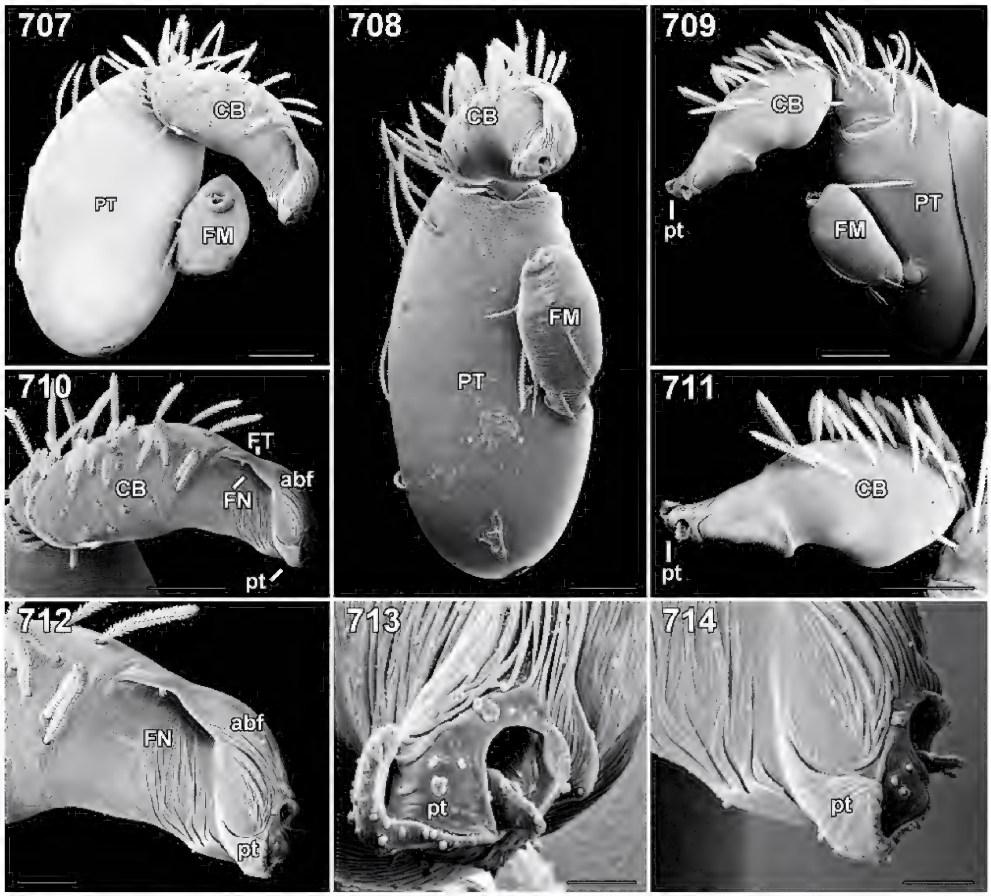
VARIATION: Male: TL: 1.45–1.48; CL: 0.68–0.69; CW: 0.55–0.58; AL: 0.80–0.90; AW: 0.62–0.65.

Female: TL: 1.73–1.74; CL: 0.67–0.70; CW: 0.60–0.61; AL: 1.06–1.06; AW: 0.83–0.87.

NATURAL HISTORY: *O. manongarivo* was found in mountain rainforest at high elevation (780–1175 m).

DISTRIBUTION: *O. manongarivo* was mostly found in the northern and northeastern regions of Madagascar in the province of Antsiranana (Réserve spéciale de Manongarivo) (map 2).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Antsiranana:** RS Manongarivo, 14.5 km 220° SW Antanambao, S13°59.9′, E48°20′25.7″, 1175 m elevation, 20 October



Figs. 707–714. *Opopaea namoroka,* n. sp., male palp. **707.** Prolateral view. **708.** Ventral view. **709.** Retrolateral view. **710, 712.** Close up, prolateral view. **711.** Retrolateral view. **713.** Embolar region, anterior view. **714.** Prolateral view. Scale bars: 707–709 = 30 μm; 708, 710–711 = 20 μm; 712 = 10 μm; others = 4 μm.

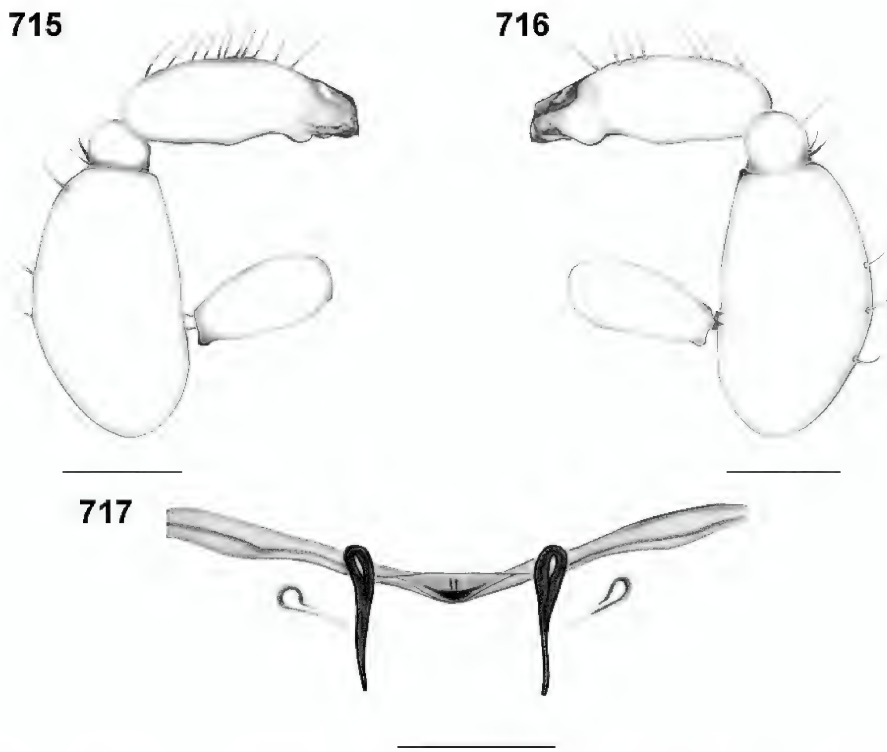
1998, rainforest, sifted litter, B.L. Fisher (CASC PBI_OON 3717), 2♂, 1♀ (CASC PBI_OON 2000), 19♂, 26♀. 12.8 km 228° SW Antanambao, 13°58.6′S, 48°25.4′E, 780 m, sifted litter, montane rainforest, 11 October 1998, coll. B.L. Fisher (CASC. PBI_OON 3847), 4♂, 8♀.

Opopaea maroantsetra, new species
Figures 85, 648–682; map 2

TYPES: Male holotype and female allotype from Madagascar: Toamasina: Forêt de Maroantsetra, Ambohivoangy, 1946, 15.44309°S, 49.7351°E, J. Millot (NHM PBI_OON 34311). Ambodifototra, île Nosy Boraha, Sainte-Marie, Antsarahaka. Lonkintsy, près de l'hôtel La Crique, proximité plage, 0–10 m, 17.0042°S, 49.8559°E, 07 December 1989, C. Lienhard (NHM PBI_OON 35135), 1♀ paratype.

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. maroantsetra* can most easily be distinguished from those of other *Opopaea* species by a globulous cymbiobulbus longer than patella with a very large proximal bulge. Palp tip very short, sclerotized at the top and curved upward (figs. 648, 649, 664, 665, 668, 669, 672–682). Females of *O. maroantsetra* can be easily recognized by a more or less thick and weakly sclerotized scutal ridge that medially curves inward and is fused with the postgynum depression ridge, bearing at its posterior top a round parmula (figs. 650, 670, 671).

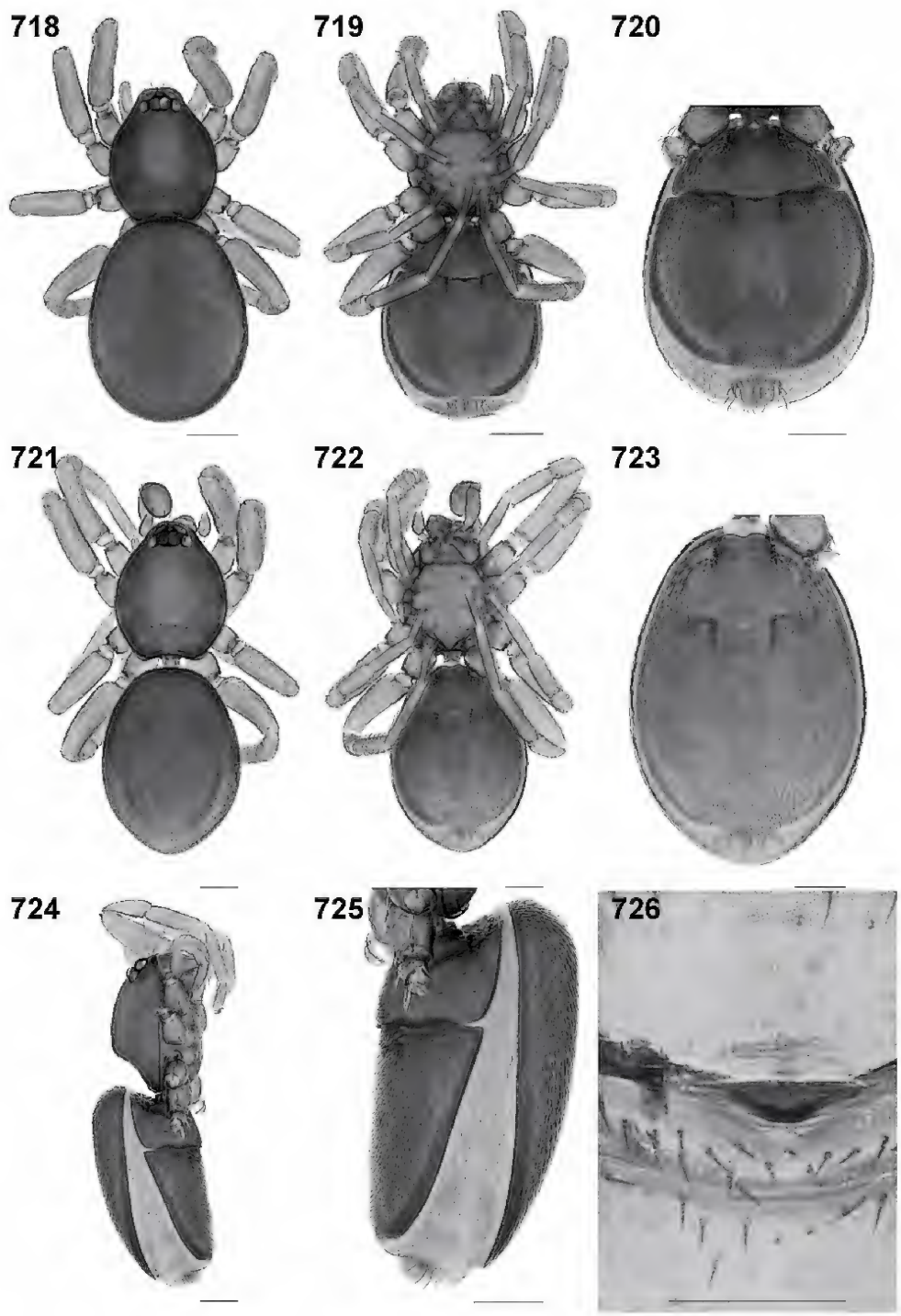


Figs. 715–717. *Opopaea sandranantitra,* n. sp. **715.** Palp prolateral view. **716.** Palp retrolateral view. **717.** Epigynum, dorsal view. Scale bars: 0.1 mm.

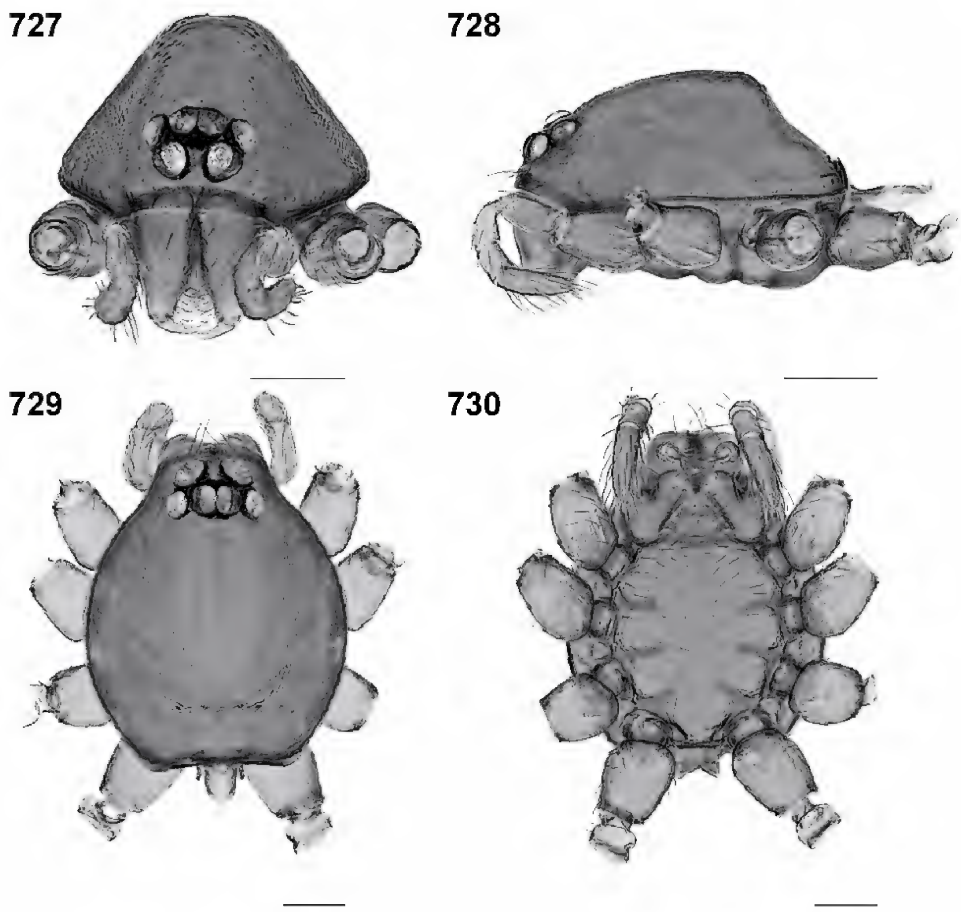
DESCRIPTION: Male (holotype) (PBI_OON 34311). Small species. Total length 1.28. Color: yellowish orange. Carapace: pars cephalica not elevated posteriorly with one row of two sets of four recurved denticles (figs. 661, 662). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes small to medium sized. ALE and PME largest and oval, PLE circular; PME darkened compared to other eyes, posterior eye row straight viewed from above, slightly procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, shape of posterior part between coxae IV hexagonal then slightly constricted into a short rectangular (figs. 663). Lateral margins of area between coxae III unmodified, without lumps; setae sparse but evenly distributed, originating from surface, without hair tufts. Cymbiobulbus posterior margin with a very large and smooth proximal protuberance and a small distal one. Palpal fenestra large and located near the tip of the palp, fenestral top depressed (figs. 648, 649, 664, 665, 668, 669, 672–682).

Female (paratype from Ambodifototra) (PBI_OON 35135). Total length 1.56. Yellowish orange, abdomen elongated and not flattened posteriorly, ventral scutum posterior end usually rectangular. Postgynum depression one third longer than the distance between the lateral apodemes and one and a half times deeper than the distance between epigastric furrow and the shallow groove connecting the tracheal spiracles; ridge very thick and weakly sclerotized (figs. 147, 690, 691).

MEASUREMENTS: Male (holotype) (PBI_OON 34311). TL: 1.28; CL: 0.52; CW: 0.41; CH: 0.23; AL: 0.76; AW: 0.50; ALE: 0.07; PME: 0.06; PLE: 0.05; EGW: 0.17; ALE-ALE: 0.01; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.01; CBL: 0.19; CBW: 0.1; CBL/PTL: 1.18; FI: 0.06.



Figs. 718–726. *Opopaea sandranatitra,* n. sp. **718.** Female, habitus, dorsal view. **719.** Ventral view. **720.** Abdomen, ventral view. **721.** Male, habitus, dorsal view. **722.** Ventral view. **723.** Abdomen, ventral view. **724.** Habitus, lateral view. **725.** Abdomen, lateral view. **726.** Epigynum, dorsal view. Scale bars: 0.2 mm.



Figs. 727–730. *Opopaea sandranantitra,* n. sp., female. **727.** Carapace, anterior view. **728.** Lateral view. **729.** Dorsal view. **730.** Ventral view. Scale bars: 0.2 mm.

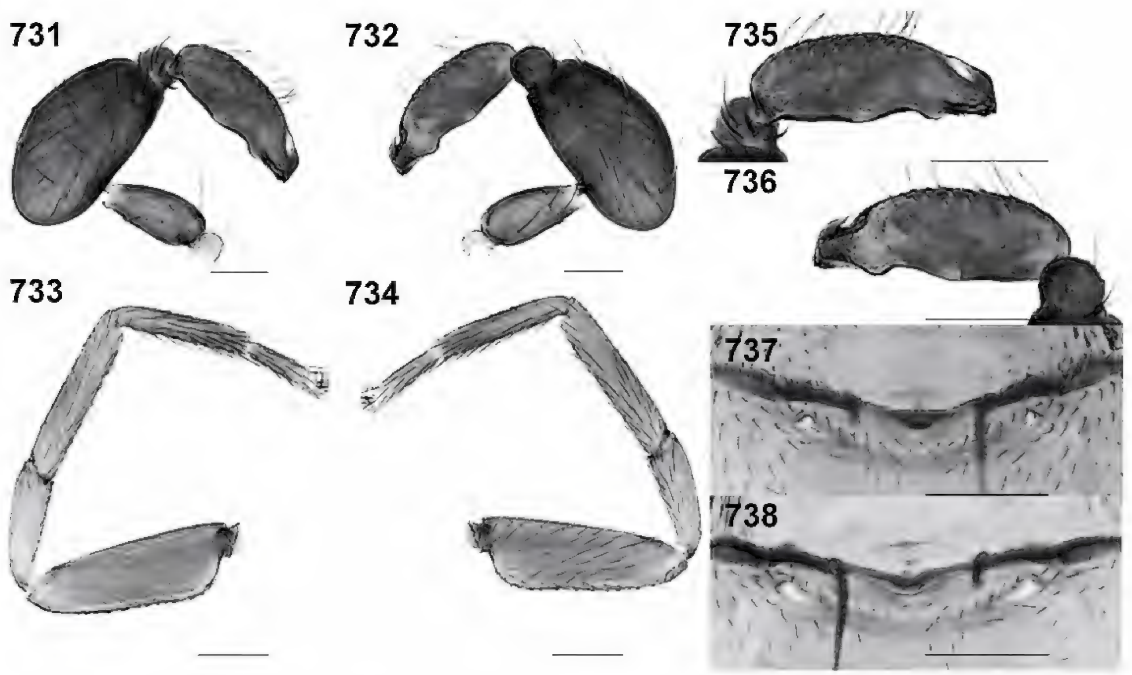
Female (paratype from Ambodifototra) (PBI_OON 35135). TL: 1.56; CL: 0.57; CW: 0.44; CH: 0.24; AL: 0.96; AW: 0.62; ALE: 0.06; PME: 0.07; PLE: 0.06; EGW: 0.16; ALE-ALE: 0.01; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.01; EFL: 0.12; LAL: 0.06; PGI (LAL/EFL): 0.5; PDL/LAL: 0.33; PDW/EFL: 0.58.

VARIATION: Male: TL: 1.28–1.41; CL: 0.52–0.58; CW: 0.41–0.46; AL: 0.76–0.82; AW: 0.50–0.51.

NATURAL HISTORY: *O. maroantsetra* was mostly found in rainforests, secondary forests near the beach, mango plantations, and dead wood at low elevation (around 15 m).

DISTRIBUTION: *O. maroantsetra* was mostly found on the east coast and in the north of Madagascar in the provinces of Toamasina and Antsiranana (Maroantsetra, Ambodifototra. Foulpointe, Andoany) and on Mohéli, one of the islands of the Comoros (map 2).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Antsiranana:** Sous-préf Andoany (Hell-ville), Nosy be, Réserve Lokobe, forêt secondaire près d'Ampasipony, S13.39796°, E48.32439°, 15 m, 29 November 1983, general collecting, sous écorces. B. Hauser (NHM PBI_OON 35137), 1♀. **Toamasina:** Foulpointe, forêt de lagune, S17.6813°, E49.51057°, October 1993, aspirateur, bois pourri, Pauly A. (MRAC PBI_OON 9795), 1♂. Forêt sur argile, tamisage litière, December 1993, Pauly A. (MRAC PBI_OON 9799), 1♂. COMOROS: **Mohéli:** Miringoni, plantation d'Ilang ilang, mangiers et arbre longeant la plantation, litière, tamisage, 04 November 1993, R. Jocqué (MRAC PBI_OON 28571), 1♂.



Figs. 731–738. *Opopaea sandranantitra,* n. sp. **731.** Male, palp, prolateral view. **732.** Retrolateral view. **733.** Leg IV, prolateral view. **734.** Retrolateral view. **735.** Male, palp, close up, prolateral view. **736.** Retrolateral view. **737.** Epigynum, ventral view. **738.** Dorsal view. Scale bars: figures 733, 734 = 0.2 mm; others = 0.1 mm.

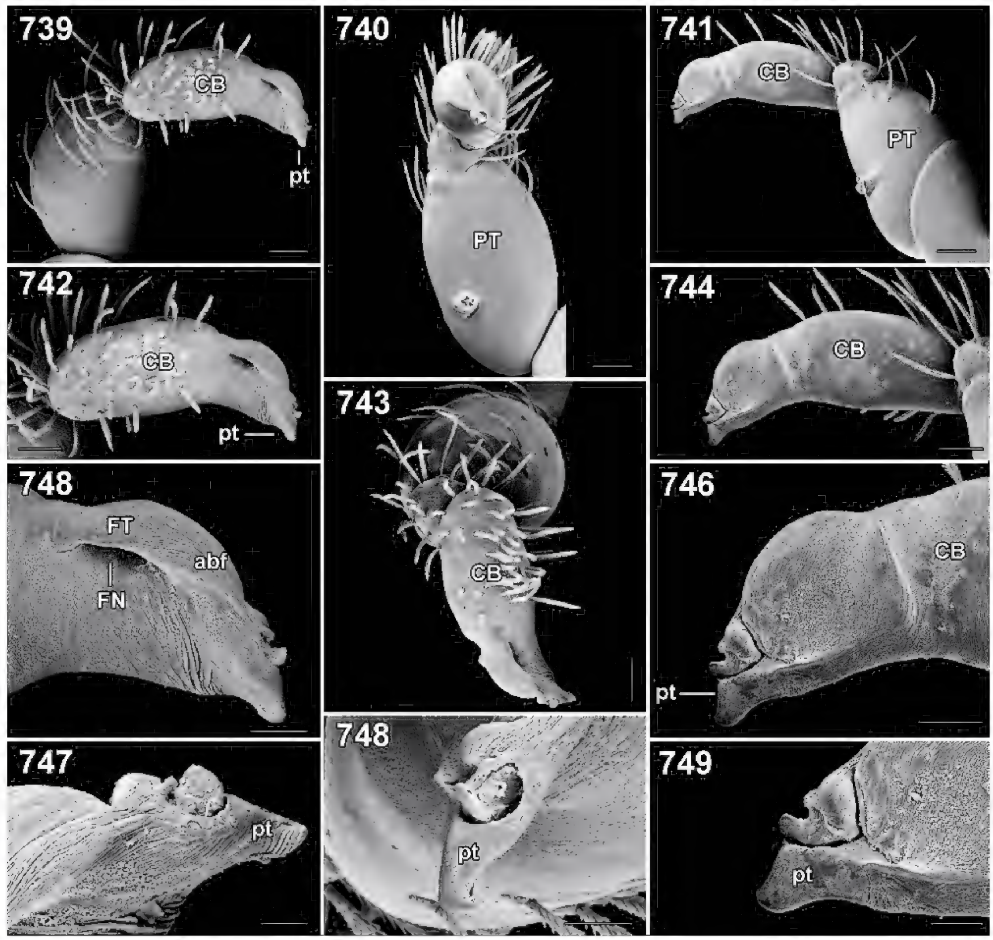
Opopaea namoroka, new species
Figures 10, 16, 20, 41, 47, 70, 683–714; map 4

TYPES: Male holotype and female allotype from Mahajanga: Park National Namoroka, 17.8 km 329° WNW Vilanandro, 16°22′36″S, 45°19′36″E, 100 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 8–12 November 2002, Fisher and Griswold et al. (CASC PBI_OON 3774).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. namoroka* can be distinguished from those of other *Opopaea* species by the very thin and elongated cymbiobulbus, half the width of the patella, curving downward with a very large posteroproximal protuberance with a very large and elongated fenestra, a short and round anterior part bearing a sclerotized and compact extension whose tip folds on one side (figs. 683, 684, 699, 700, 703, 704, 707–714). Females of *O. namoroka* can be recognized by the medially thick scutal ridge that bears a short sclerotized bulge and by the more or less round parmula, very small, above scutal ridge (figs. 150, 722, 723).

DESCRIPTION: Male (holotype) (PBI_OON 3774). Small species. Total length 1.02. Color: yellowish orange. Carapace: pars cephalica elevated with two widely separated humps each bearing two denticles (figs. 696, 697), carapace anteriorly narrowed to less than one third its maximum width. Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes medium sized to small. PME largest. ALE, PME, and PLE oval; PME darkened compared to other eyes, posterior eye row straight viewed from above, straight from front; ALE separated by their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface without pits, shape of posterior part between coxae IV narrow, hexagonal (fig. 698), not constricted. Lateral margins



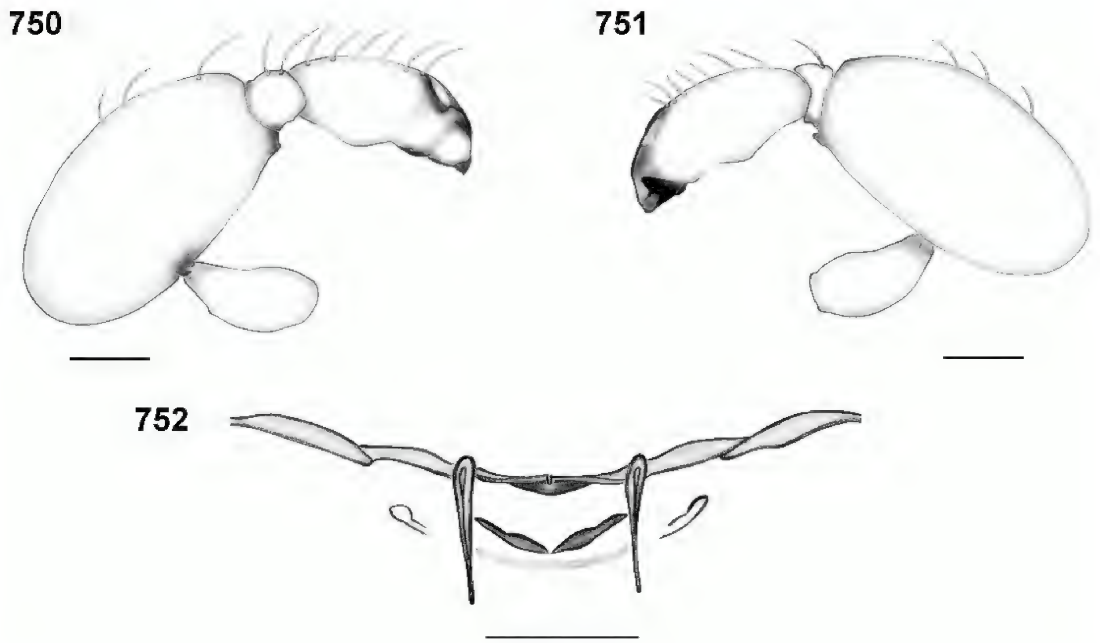
Figs. 739–749. *Opopaea sandranantitra,* n. sp., male palp. **739.** Prolateral view. **740, 743.** Ventral view. **741.** Retrolateral view. **742, 745.** Close up, prolateral view. **744–746.** Retrolateral view. **747.** Embolar region, prolateral view. **748.** Anterior view. **749.** Retrolateral view. Scale bars: figures 739–741, 743 = 30 μm; figures 742, 744 = 20 μm; figures 746, 748 = 10 μm; others = 4 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FN,** fenestra; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

of area between coxae III unmodified, without lumps, setae sparse, dark, needlelike, and densest laterally, originating from surface, without hair tufts (figs. 695–698). Cymbiobulbus elongated with posterior margin straight and with two posterior protuberances, a large smooth proximal one and a tiny, barely visible sclerotized distal one. Palpal femora half the size of palpal patella and inserted in the middle of the patella. Palpal fenestra large and elliptical, located at one third the length of the palpal tip; fenestra top flat, area before fenestra slightly elevated (figs. 683, 684, 699, 700, 703, 704, 707–714).

Female (allotype) (PBI_OON 3774). Total length 1.52. Abdomen round, not flattened. Postgynum depression arclike, more or less short, narrow and barely visible dorsally but with a median sclerotized ridge ventrally (figs. 685, 705, 706).

MEASUREMENTS: Male (holotype) (PBI_OON 3774) TL: 1.02; CL: 0.54; CW: 0.46; CH: 0.22; AL: 0.76; AW: 0.51; ALE: 0.06; PME: 0.07; PLE: 0.07; EGW: 0.19; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PME-PLE: 0.01; CBL: 0.19; CBW: 0.07; CBL/PTL: 0.70; FI: 0.12.

Female (allotype) (PBI_OON 3774) TL: 1.52; CL: 0.64; CW: 0.49; CH: 0.25; AL: 0.9;



Figs. 750–752. *Opopaea torotorofotsy,* n. sp. **750.** Male, palp prolateral view. **751.** Retrolateral view. **752.** Epigynum, dorsal view. Scale bars: 0.1 mm.

AW: 0.68; ALE: 0.07; PME: 0.07; PLE: 0.06; EGW: 0.19; ALE-ALE: 0.04; ALE-PLE: 0.01; PME-PME: 0; PME-PLE: 0.02; EFL: 0.14; LAL: 0.06; PGI (LAL/EFL): 0.43; PDL/LAL: 0.50; PDW/EFL: 0.36.

VARIATION: Male: TL: 1.02–1.04; CL: 0.54–0.60; CW: 0.46–0.48; AL: 0.76–0.86; AW: 0.51–0.68.

Female: TL: 1.40–1.52; CL: 0.54–0.64; CW: 0.46–0.50; AL: 0.86–0.9; AW: 0.74–0.76.

NATURAL HISTORY: *O. namoroka* was mostly collected in tropical dry forest at low elevation.

DISTRIBUTION: *O. namoroka* was found in northwestern Madagascar in the province of Mahajanga (Park National Namoroka, Androngonibe) (map 4).

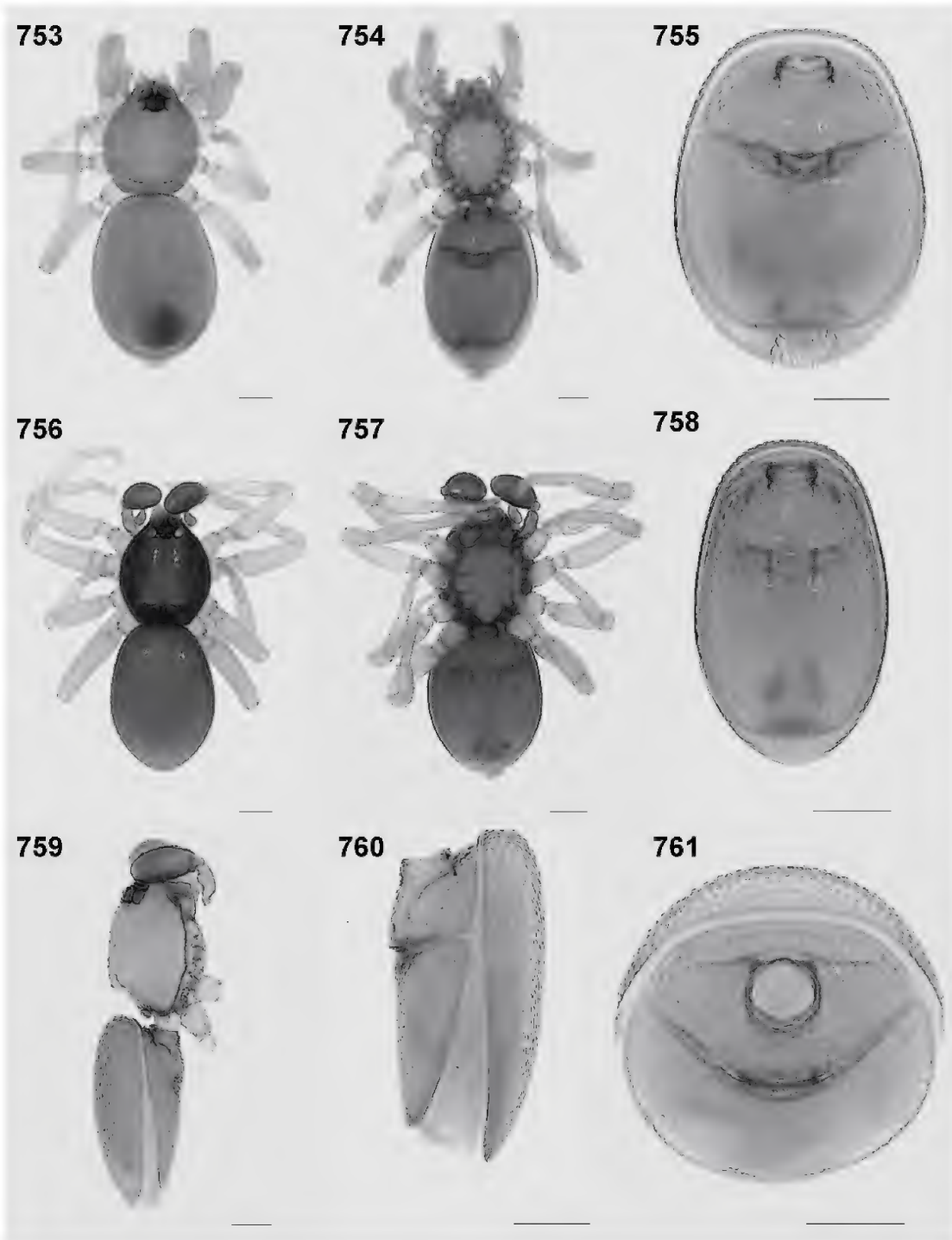
OTHER MATERIAL EXAMINED: MADAGASCAR: **Antananarivo:** Tsimbazaza, S18.93036°, E47.52693°, general collecting, November 1946, C.J. Millot (PBI_OON 34310), 1♂, 5♀ (PBI_OON 34307), 1♀ (PBI_OON 34308), 1♀ (PBI_OON 35119), 1♂, 4♀. Ambohimanga, S20°52′, E 47°36′, general collecting, December 1946, C.J. Millot (PBI_OON 35121), 1♀. **Mahajanga:** Park National Namoroka, 17.8 km 329° WNW Vilanandro, 16°22′36″S, 45°19′36″E, 100 m, EF19 sifted litter (leaf mold, rotten wood), tropical dry forest, 8–12 November 2002, Fisher and Griswold, et al. (CASC PBI_OON 3774), 1♂, 4♀.

Opopaea sandranantitra, new species
Figures 715–749; map 3

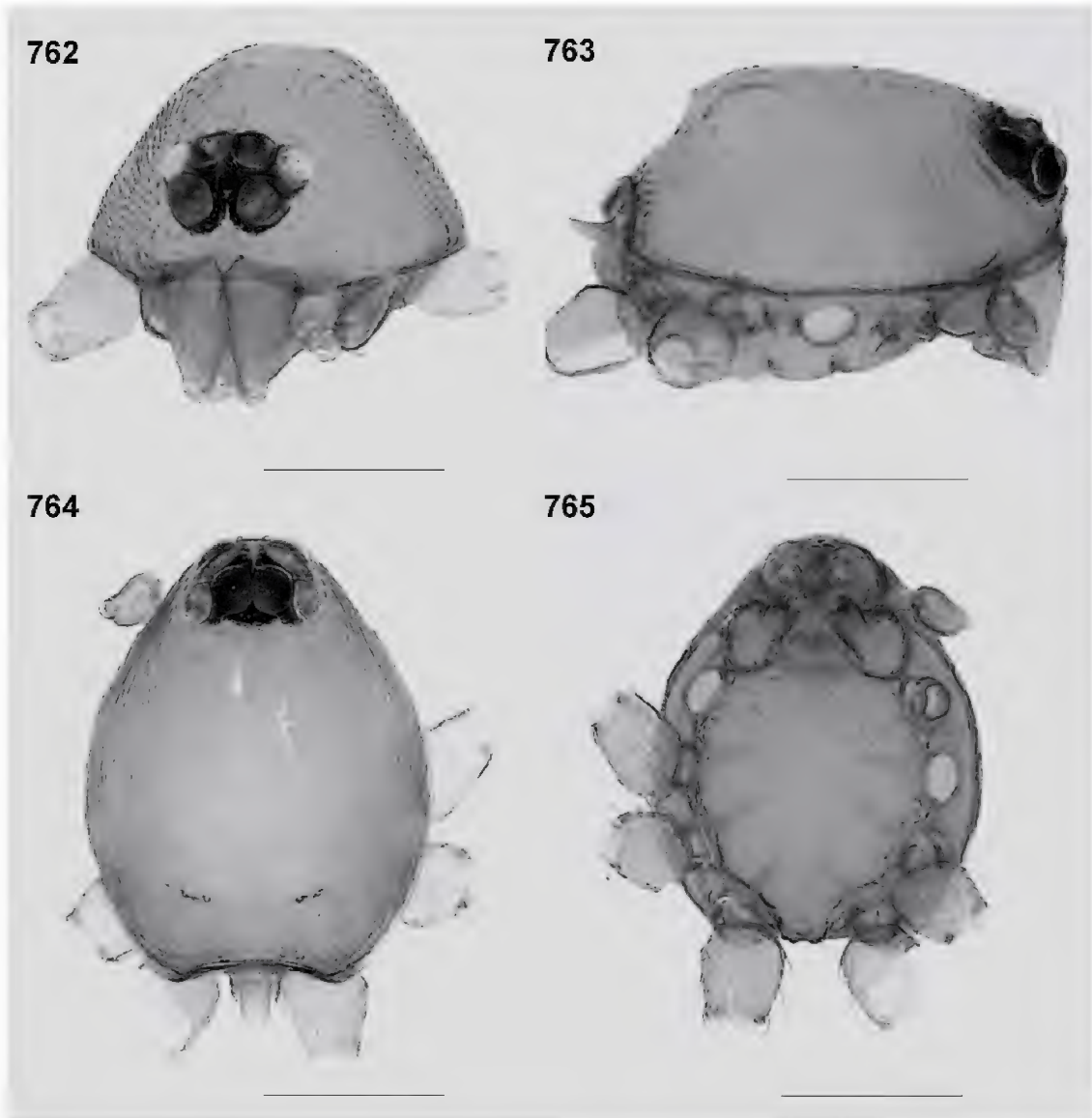
TYPES: Male holotype and female allotype from Toamasina province: Forêt classée de Sandranantitra, rainforest, 18°2.9′S, 49°5.5′E, 450 m, sifted litter, 18–21 January 1999, H.J. Ratsirarson (CASC PBI_OON 3710).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. sandranatitra* can most easily be distinguished from those of other *Opopaea* species by an elongated cymbiobulbus, longer than the patella with posterior edge straight with only one distal protuberance and anterior edge truncated, almost rectangular (figs. 715, 716, 731, 732, 735, 736, 739–749). Females of *O. sandranantitra* can easily be recognized by a divided and very heavily sclerotized, and thick border of the epigastric furrow that drops medially



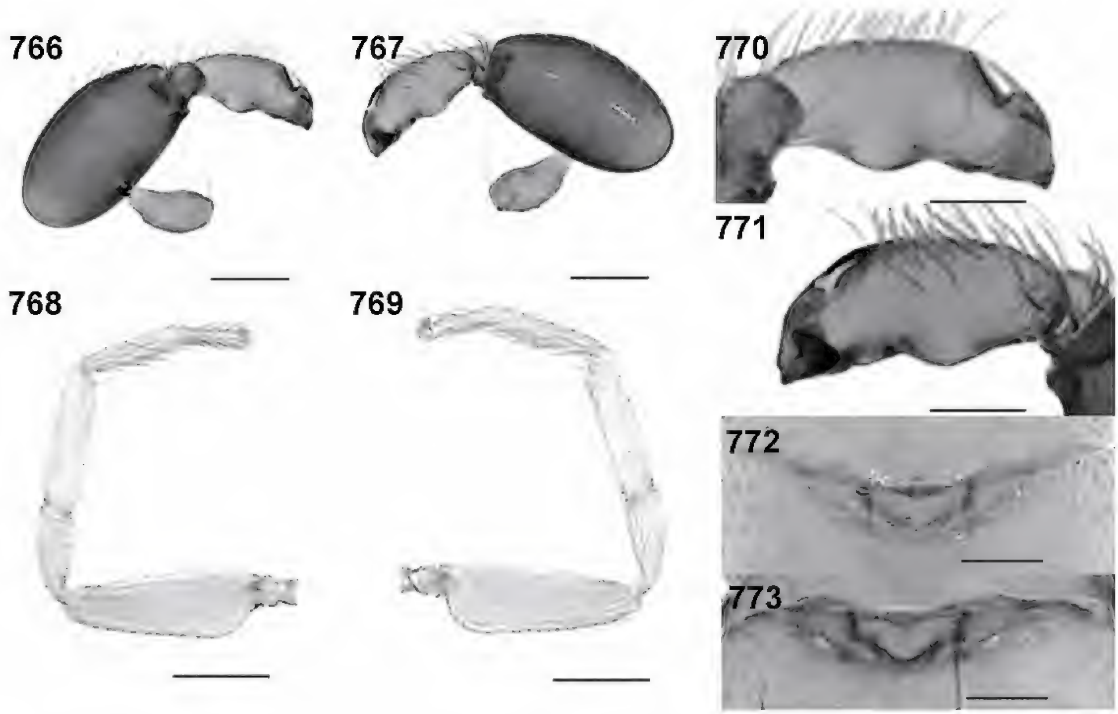
Figs. 753–761. *Opopaea torotorofotsy,* n. sp. **753.** Female, habitus, dorsal view. **754.** Habitus, ventral view. **755.** Abdomen, ventral view. **756.** Male, habitus, dorsal view. **757.** Ventral view. **758.** Abdomen, ventral view. **759.** Lateral view. **760.** Abdomen, lateral view. **761.** Anterior view. Scale bars: 0.2 mm.



Figs. 762–765. *Opopaea torotorofotsy,* n. sp., female. **762.** Carapace, anterior view. **763.** Lateral view. **764.** Dorsal view. **765.** Ventral view. Scale bars: 0.2 mm.

into an inverse arclike sclerotized bulge above which a small cylindrical parmula is found (figs. 717, 737, 738).

DESCRIPTION: Male (holotype) (PBI_OON 3710). Large species. Total length 2.1. *Color:* dark orange. Carapace: pars cephalica elevated posteriorly with one row of four denticles (figs. 728, 729). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes medium sized to large. ALE largest. ALE oval, PME and PLE circular; PME darkened compared to other eyes, posterior eye row straight viewed from above, straight from front; ALE separated by almost their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between



Figs. 766–773. *Opopaea torotorofotsy,* n. sp. **766.** Male, palp, prolateral view. **767.** Retrolateral view. **768.** Leg IV, prolateral view. **769.** Retrolateral view. **770.** Male, palp, close up, prolateral view. **771.** Retrolateral view. **772.** Epigynum, ventral view. **773.** Dorsal view. Scale bars: figures 768, 769 = 0.2 mm; others = 0.1 mm.

coxae, surface smooth, without pits, shape of posterior part between coxae IV hexagonal, narrowed neither medially nor near the end (fig. 730). Lateral margins of area between coxae III unmodified, without lumps; setae more or less abundant, evenly distributed, originating from surface, without hair tufts (figs. 727–730). Cymbiobulbus tip sclerotized without extensions and fenestra top not raised, but continuing anteriorly into a square sclerotized area. Fenestra small and elongated oriented obliquely, located near the end of the palp. Palpal femora long, about two thirds the length of the palpal patella and inserted medially to it (figs. 715, 716, 731, 732, 735, 736, 739–749).

Female (allotype) (PBI_OON 3710). Total length 2.37. Dark orange, abdomen almost circular, not flattened, and truncated posteriorly. Postgynum depression more or less short and wide, ridge thin and not sclerotized (figs. 717, 737, 738).

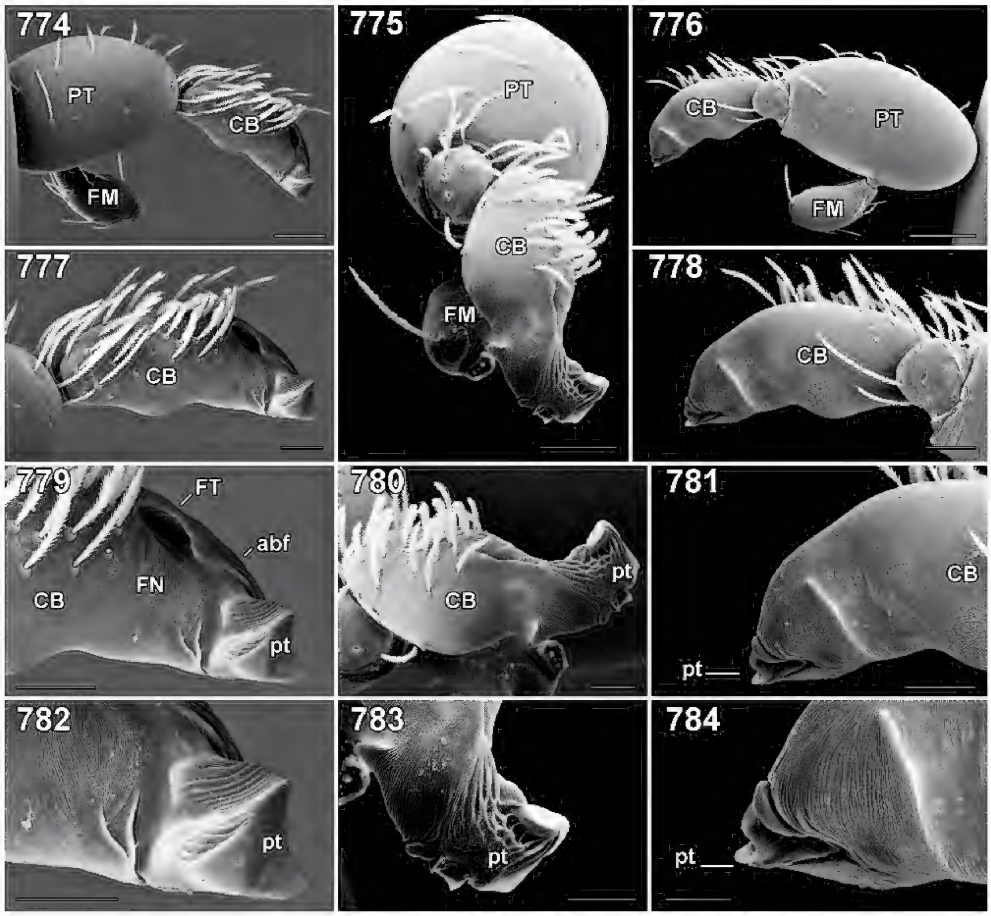
MEASUREMENTS: Male (holotype) (PBI_OON 3710). TL: 2.1; CL: 0.89; CW: 0.73; CH: 0.42; AL: 1.23; AW: 0.85; ALE: 0.11; PME: 0.09; PLE: 0.08; EGW: 0.27; ALE-ALE: 0.04; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.01; CBL: 0.30; CBW: 0.11; CBL/PTL: 0.96; FI: 0.14.

Female (allotype) (PBI_OON 34407). TL: 2.37; CL: 0.98; CW: 0.77; CH: 0.44; AL: 1.45; AW: 1.13; ALE: 0.12; PME: 0.09; PLE: 0.09; EGW: 0.29; ALE-ALE: 0.06; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.02; EFL: 0.27; LAL: 0.12; PGI (LAL/EFL): 0.44; PDL/LAL: 0.5; PDW/EFL: 0.22.

VARIATION: Female: TL: 2.34–2.37; CL: 0.98–0.99; CW: 0.76–0.77; AL: 1.42–1.47; AW: 1.08–1.13.

NATURAL HISTORY: *O. sandranantitra* was mostly found in rainforest and montane rainforest from 450–1068 m elevations.

DISTRIBUTION: *O. sandranantitra* is mostly found on the east coast of Madagascar in the province of Toamasina (Sandranantitra, Analamay) (map 3).



Figs. 774–784. *Opopaea torotorofotsy,* n. sp., male palp. **774.** Prolateral view. **775.** Anterior view. **776.** Retrolateral view. **777, 779.** Close up, prolateral view. **778, 781.** Retrolateral view. **780.** Dorsal view. **782.** Embolar region, prolateral view. **783.** Dorsal, view. **784.** Retrolateral view. Scale bars: figures 774, 776 = 30 μm; figure 775 = 40 μm; figures 777, 778, 780 = 20 μm; figures 779, 781 = 15 μm; others = 10 μm.

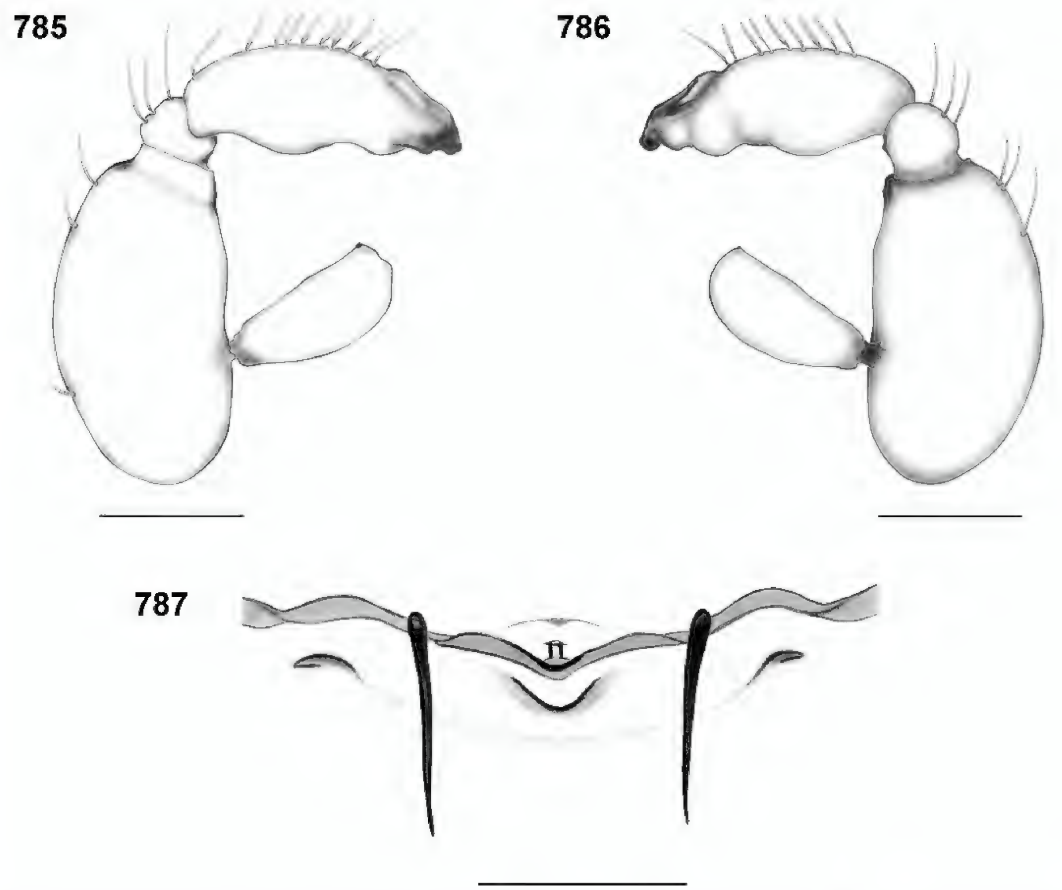
OTHER MATERIAL EXAMINED: MADAGASCAR: **Toamasina:** Analamay, montane rainforest, 18°48′22″S, 48°20′13″E, 1068 m, sifted litter, 21 March 2004, colls. Malagasy ant team, BLF10502 (CASC PBI_OON 3788), 1♀. Sandranantitra, Forêt classée de Sandranantitra, rainforest, 18°2.9′S, 49°5.5′E, 450 m, sifted litter, 18–21 January 1999, H.J. Ratsirarson (CASC PBI_OON 3710), 2♂.

Opopaea torotorofotsy, new species
Figures 87, 750–784; map 2

TYPES: Male holotype and female allotype from Toamasina province, Torotorofotsy, 18°52′15″S, 48°20′51″E, 1070 m, sifted litter (leaf mold, rotten wood), marsh edge, montane rainforest, 24 March 2004, colls. Malagasy ant team (CASC PBI_OON 3754).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. torotorofotsy* can be distinguished from those of other *Opopaea* species by the tip of the cymbiobulbus, with a long engrossed, leaflike sclerotized extension prolaterally directed (figs. 751, 767, 771, 779, 782). Females of *O. torotorotsy* can be easily recognized by an arclike postgynum depression as wide as the distance between the lateral apodemes and almost as long as the distance between epigastric furrow and the shallow groove connecting the tracheal spiracles and by the postgynum depression ridge,

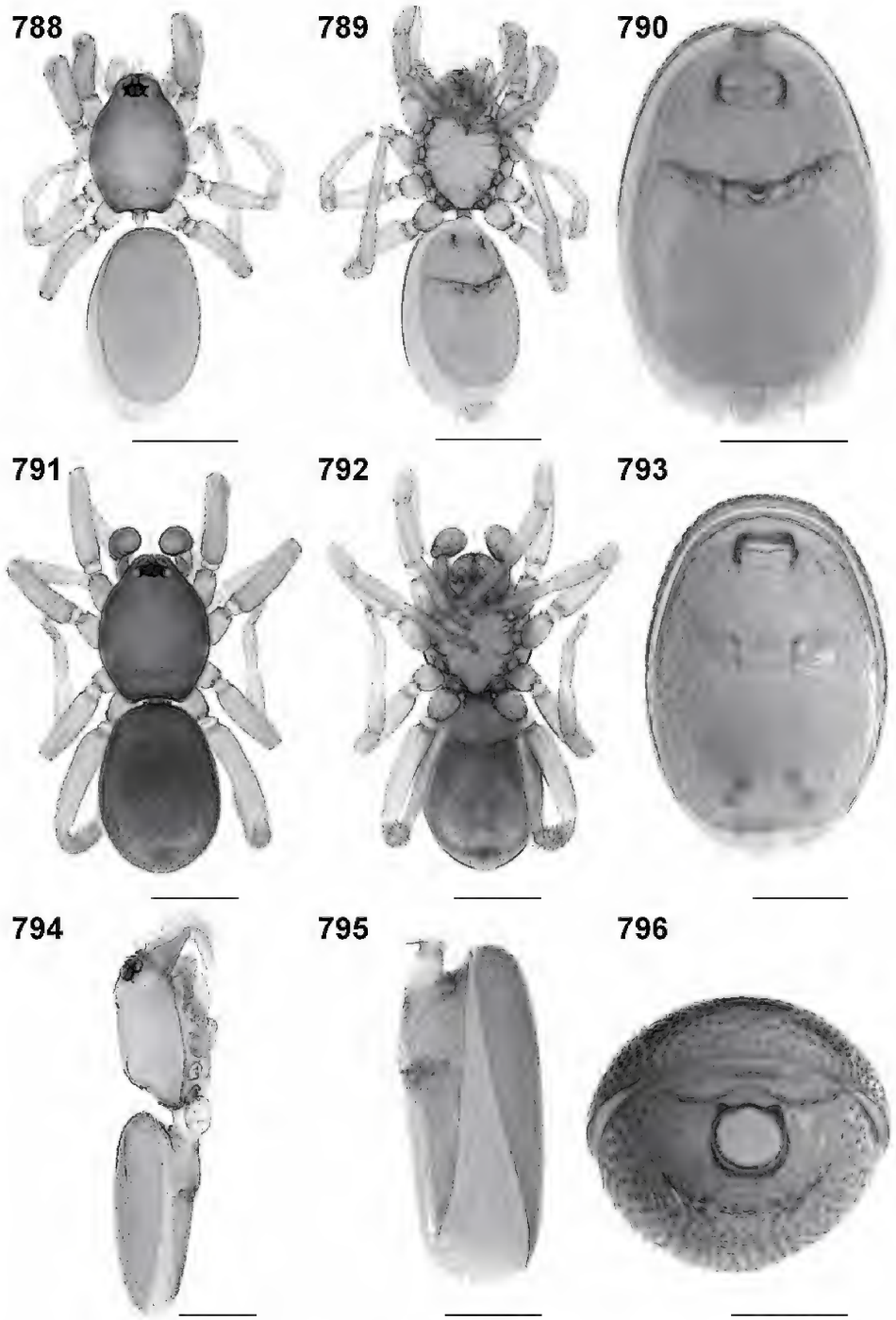


Figs. 785–787. *Opopaea tsimaloto,* n. sp. **785.** Male, palp, prolateral view. **786.** Retrolateral view. **787.** Epigynum, dorsal view. Scale bars: 0.1 mm.

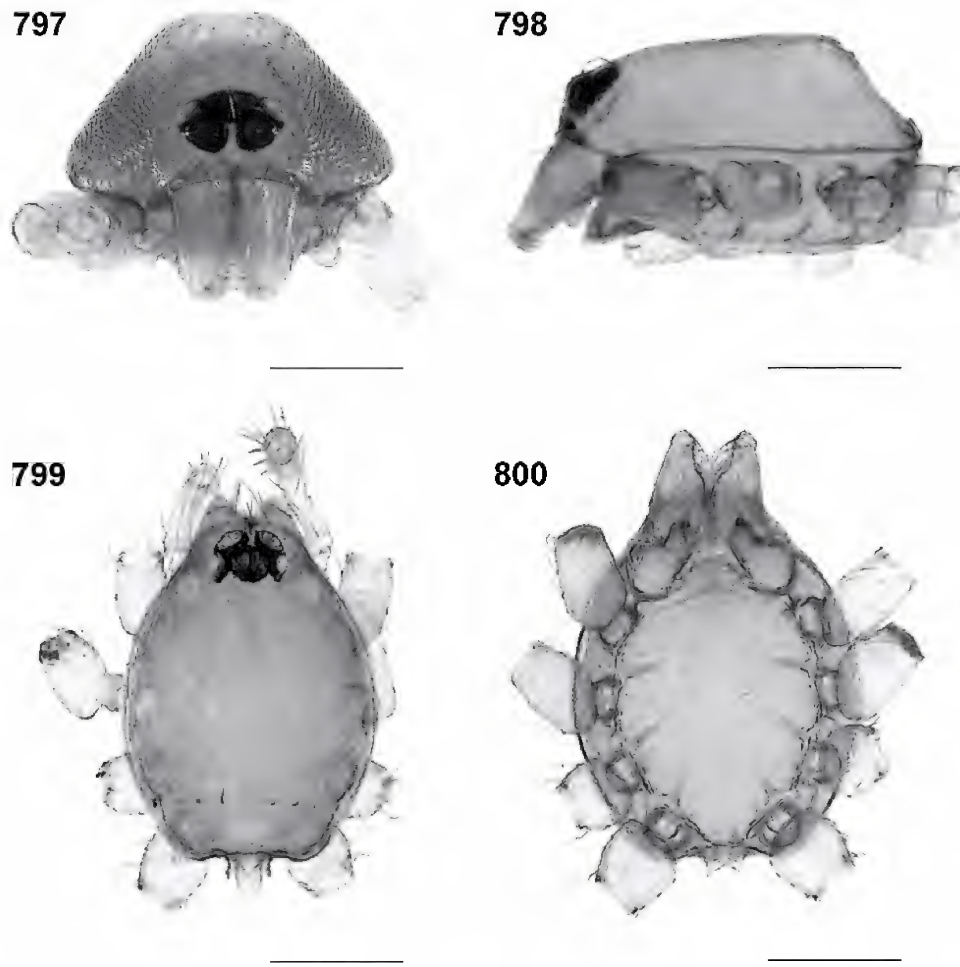
sclerotized and more or less thick only in its posteromedian part (figs. 752, 772, 773).

DESCRIPTION: Male (holotype) (PBI_OON 3754). Small to medium-sized species. Total length 1.57. Color: brown orange to yellowish orange. Carapace: pars cephalica elevated posteriorly with one row of two sets of three denticles bearing long and thick hairs directed 90° perpendicular to carapace top (figs. 763, 764), carapace anteriorly narrowed to one third maximum width. Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum present, undivided. Eyes medium sized. ALE largest. ALE oval, PME and PLE circular; PME darkened compared to other eyes, posterior eye row straight viewed from above, procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, shape of posterior part between coxae IV hexagonal, not constricted. Lateral margins of area between coxae III unmodified, without lumps; setae sparse, dark, needlelike, densest laterally, originating from surface, without hair tufts (figs. 762–765). Posterior margin with one proximal protuberance and curved downward. Palpal femora half the size of palpal patella and inserted medially to it. Palpal fenestra enlarged anteriorly and more or less large and located at one third the length of the palp; fenestra top not raised as is the area before fenestra (figs. 750, 751, 766, 767, 770, 771, 774–784).

Female (allotype) (PBI_OON 3754). Total length 1.72. Brown yellowish to yellowish



Figs. 788–796. *Opopaea tsimaloto,* n. sp. **788.** Female, habitus, dorsal view. **789.** Ventral view. **790.** Abdomen, ventral view. **791.** Male, habitus, dorsal view. **792.** Ventral view. **793.** Abdomen, ventral view. **794.** Habitus, lateral view. **795.** Abdomen, lateral view. **796.** Anterior view. Scale bars: 0.2 mm.



Figs. 797–800. *Opopaea tsimaloto,* n. sp., female. **797.** Carapace, anterior view. **798.** Lateral view. **799.** Dorsal view. **800.** Ventral view. Scale bars: 0.2 mm.

orange, abdomen round and flattened posteriorly. Scutal ridge thin and straight bearing a small parmula (figs. 752, 772, 773).

MEASUREMENTS: Male (holotype) (PBI_OON 3754). TL: 1.57; CL: 0.70; CW: 0.57; CH: 0.32; AL: 0.92; AW: 0.63; ALE: 0.08; PME: 0.07; PLE: 0.06; EGW: 0.12; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; CBL: 0.22; CBW: 0.08; CBL/PTL: 0.73; FI: 0.15.

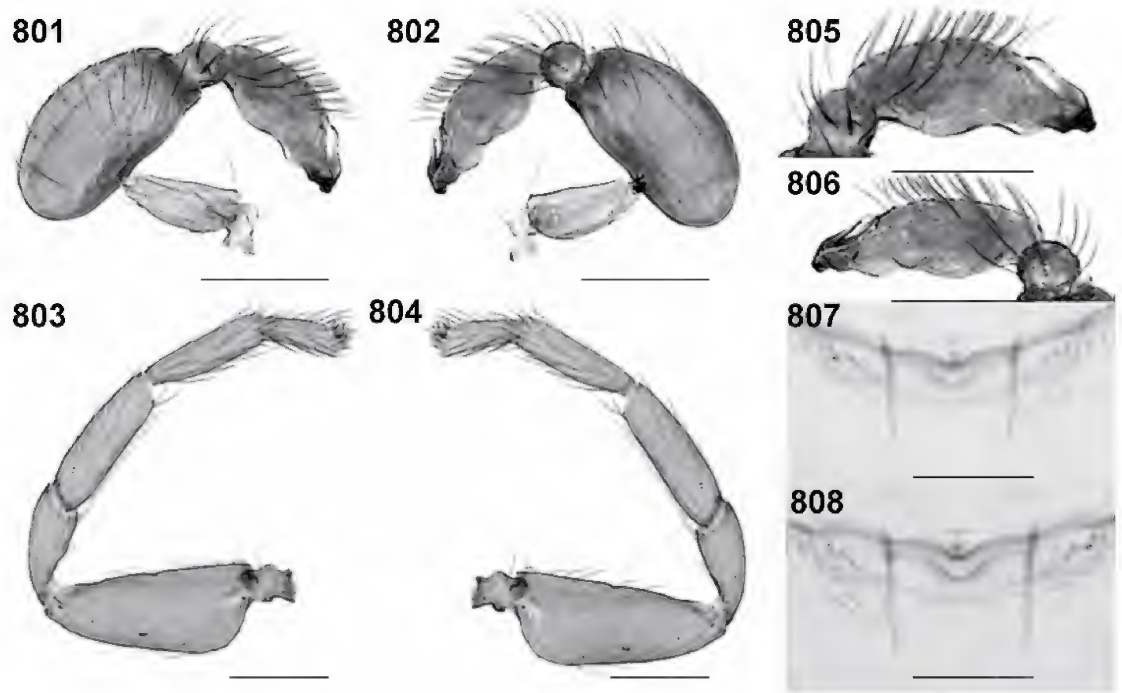
Female (allotype) (PBI_OON 3754). TL: 1.72; CL: 0.72; CW: 0.59; CH: 0.36; AL: 1.08; AW: 0.82; ALE: 0.09; PME: 0.08; PLE: 0.06; EGW: 0.21; ALE-ALE: 0.03; ALE-PLE: 0.02; PME-PME: 0; PLE-PME: 0.01; EFL: 0.18; LAL: 0.09; PGI (LAL/EFL): 0.5; PDL/LAL: 0.66; PDW/EFL: 1.

VARIATION: Male: TL: 1.3–1.72; CL: 0.56–0.7; CW: 0.44–0.57; AL: 0.71–0.92; AW: 0.52–0.63.

Female: TL: 1.5–1.72; CL: 0.63–0.73; CW: 0.48–0.58; AL: 0.92–1.04; AW: 0.65–0.82.

NATURAL HISTORY: *O. torotorofotsy* was mostly found in tropical dry forest at low elevation and in montane rainforest of the east coast. Specimens from the east coast are smaller, have larger eyes, and the posterior end of the sternum (area between coxae IV) of the males is more or less constricted compared to specimens from the dry forests.

DISTRIBUTION: *O. torotorofotsy* was mostly found in northwestern Madagascar in the province of Mahajanga (Ankarafantsika, Androngonibe, Park National Namoroka,



Figs. 801–808. *Opopaea tsimaloto,* n. sp. **801.** Male, palp, prolateral view. **802.** Retrolateral view. **803.** Leg IV, prolateral view. **804.** Retrolateral view. **805.** Male, palp, close up, prolateral view. **806.** Retrolateral view. **807.** Epigynum, ventral view. **808.** Dorsal view. Scale bars: figures 803, 804 = 0.2 mm; others = 0.1 mm.

Ambinda) and one locality (Torotorofotsy) on the east coast of the island (map 2).

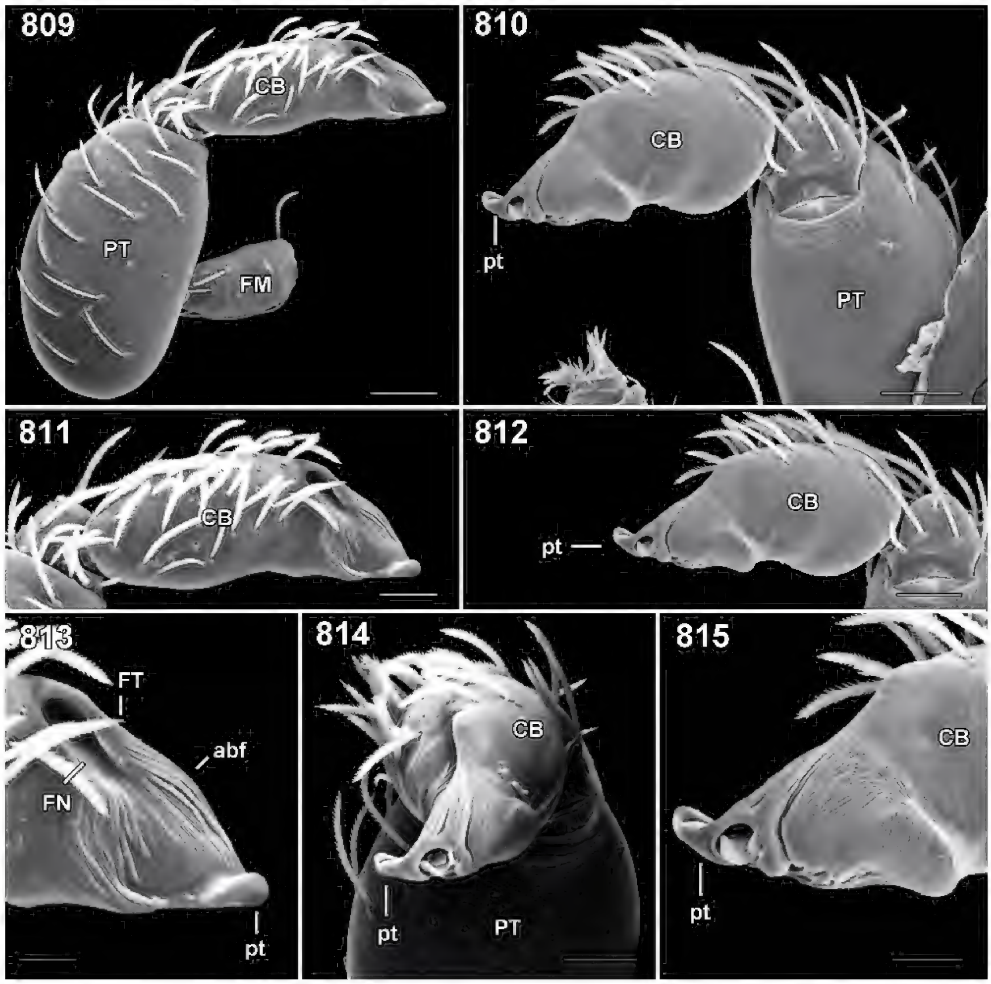
Other Material Examined: MADAGASCAR: **Mahajanga:** Androngonibe, 16.925° S, 44.3683°E, 30 m, sifted litter (leaf mold, rotten wood), tropical dry forest, 20–24 November 2006, Fisher and Griswold, et al. (CASC PBI_OON 3766), 5♂, 2♀. Park National Namoroka, 9.8 km 300° WNW Vilanandro, 16°28′00″S, 45°21′00″E, 140 m, pitfall trap (leaf mold, rotten wood), tropical dry forest, 4–8 November 2002, Fisher and Griswold et al., 1♀ (CASC PBI_OON 3785). Ambinda, 16.01°S, 45.265°E, 10 m, sifted litter (leaf mold, rotten wood), tropical dry forest, 27 November–01 December 2006, Griswold et al. (CASC PBI_OON 3769), 2♂, 7♀. PN Ankarafantsika, Ampijoroa Station Forestière, 40 km 306°NW Andranofasika, S16°19′15″, E46°48′38″, 130 m elevation, 26 March–01 April 2001, tropical dry forest, EF19 sifted litter, coll. Fisher and Griswold, et al. (CASC PBI_OON 3141), 2♂, 4♀. **Toamasina:** Torotorofotsy, 18°52′15″S, 48°20′51″E, 1070 m, sifted litter (leaf mold, rotten wood), marsh edge, montane rainforest, 24 March 2004, colls. Malagasy ant team (CASC PBI_OON 00003754), 1♀.

Opopaea tsimaloto, new species
Figures 50, 52, 785–815; map 5

Types: Male holotype and female allotype from Mahajanga province: PN Ankarafantsika, Forêt de Tsimaloto, 18.3 km 46° NE de Tsaramandroso, 16°13′41″S, 46°8′37″E, 135 m elevation, 2–8 April 2001, tropical dry forest, EF19 sifted litter, coll. Fisher and Griswold, et al. (CASC PBI_OON 3658).

Etymology: The species epithet is a name in apposition taken from the type locality.

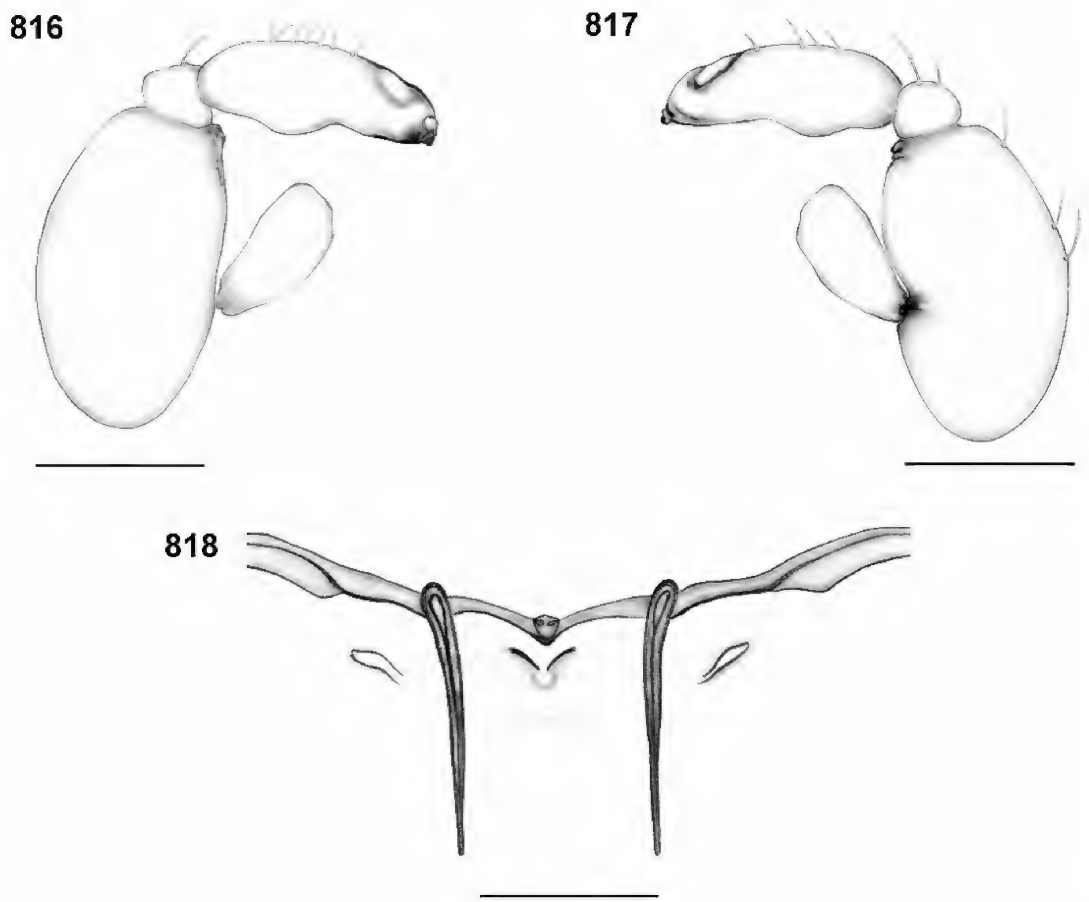
Diagnosis: Males of *O. tsimaloto* can be most easily distinguished from those of other *Opopaea* species by having the cymbiobulbus with three posterior protuberances (a large, smooth proximal one and two small distal ones, one smooth and one sharp close to palp tip) and the palp tip rounded, bearing short



Figs. 809–815. *Opopaea tsimaloto,* n. sp., male palp. **809.** Prolateral view. **810.** Retrolateral view. **811, 813.** Close up, prolateral view. **812, 815.** Retrolateral view. **814.** Anterior view. Scale bars: figures 809–810 = 30 μm; figures 811–812, 814 = 15 μm; others = 10 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FN,** fenestra; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

sclerotized extensions that pile on top of each other (figs. 786, 802, 806). Females of *O. tsimaloto* can be distinguished by having both the scutal ridge and the postgynum depression ridge medially thickened, sclerotized, and forming an inverted arc shape, the first bearing a cylindrical parmula (figs. 787, 807, 808).

DESCRIPTION: Male (holotype) (PBI_OON 3658). Small species. Total length 1.20. Color: body, legs and palp yellow, patella yellow. Carapace: pars cephalica not elevated with one almost continuous row of two sets of two denticles and a hair (figs. 798, 799), anteriorly narrowed to one half its maximum width. Carapace anterolateral corners without sclerotized, triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes small. ALE largest. ALE circular, PME oval, PLE circular; posterior eye row straight viewed from above, procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, microsculptures



Figs. 816–818. *Opopaea tsimbazaza,* n. sp. **816.** Male, palp, prolateral view. **817.** Retrolateral view. **818.** Epigynum, dorsal view. Scale bars: 0.1 mm.

only in furrows, shape of posterior part between coxae IV hexagonal. Lateral margins of area between coxae III unmodified, without lumps; setae sparse, dark, needlelike, densest laterally, originating from surface, without hair tufts (figs. 797–800). Abdomen oval, squared posteriorly, not flattened laterally. Palpal fenestra large, more or less elongated, and enlarged posteriorly. Fenestra top flat. Cymbiobulbus thinner, about half the length of patella, and of the same color as patella (figs. 785, 786, 801, 802, 805, 806, 809–815).

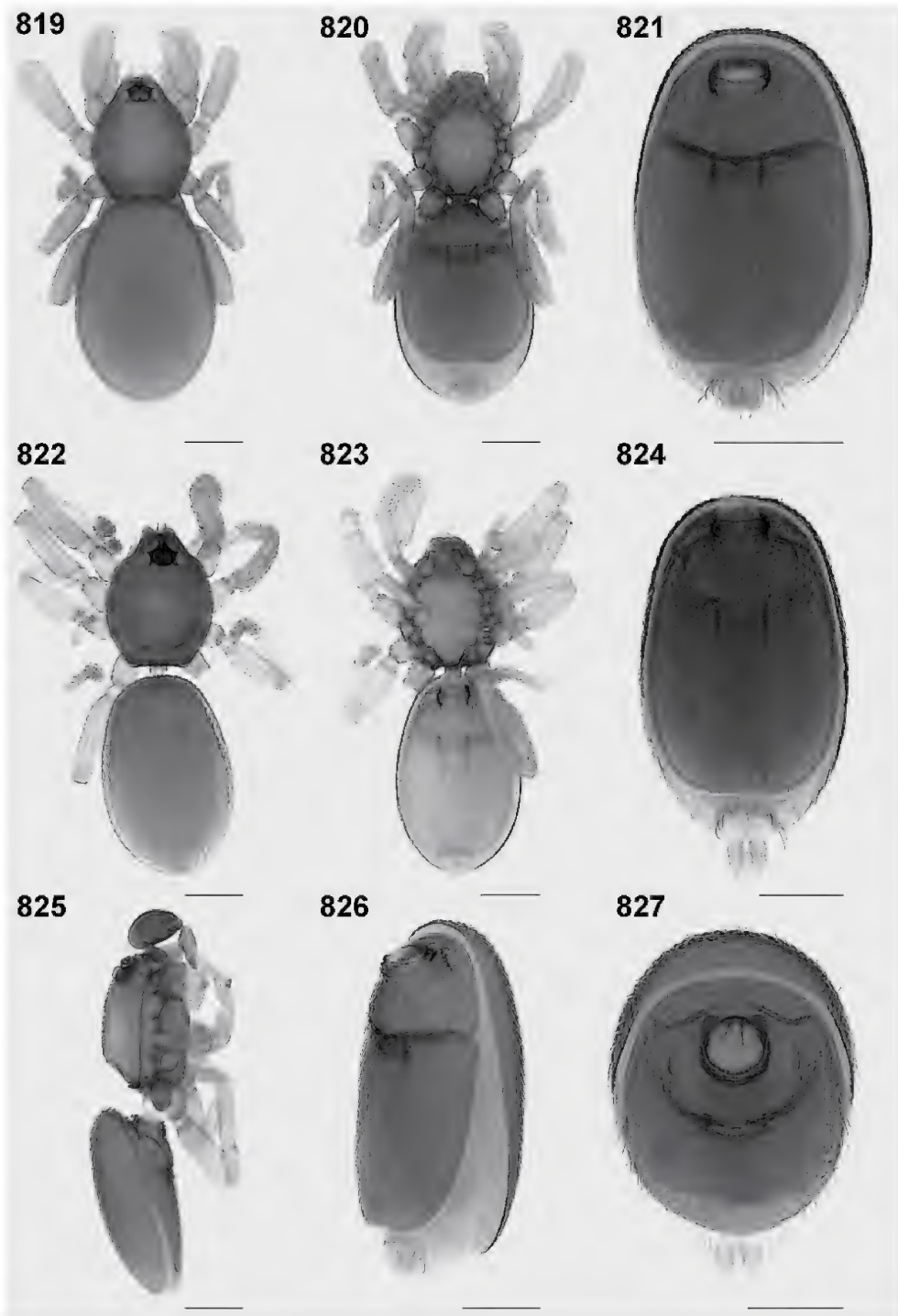
Female (allotype) (PBI_OON 3658). Total length 1.35. Postgynum depression as long as two thirds the distance between the epyginal furrow and the line connecting the tracheal spiracles and as wide as one third the distance between the two lateral apodemes; ridge medially thick and sclerotized (figs. 787, 807, 808).

MEASUREMENTS: Male (holotype) (PBI_OON 3658). TL: 1.20; CL: 0.54; CW: 0.40; CH: 0.22; AL: 0.65; AW: 0.38; ALE: 0.06; PME: 0.05; PLE: 0.04; EGW: 0.14; ALE-ALE: 0.01; ALE-PLE: 0; PME-PME: 0; PLE-PME: 0; CBL: 0.17; CBW: 0.07; CBL/PTL: 0.80; FI: 0.08.

Female (allotype) (PBI_OON 3658). TL: 1.35; CL: 0.56; CW: 0.41; AL: 0.77; AW: 0.49; EFL: 0.12; LAL: 0.05; PGI: 0.68; PDL/LAL: 0.62; PDW/EFL: 0.39.

VARIATION: TL: 1.20–1.35; CL: 0.55–0.56; CW: 0.40–0.41; AL: 0.65–0.77; AW: 0.38–0.49.

NATURAL HISTORY: *O. tsimaloto* was found in tropical dry forest and montane rainforest from 80–1410 m elevations.

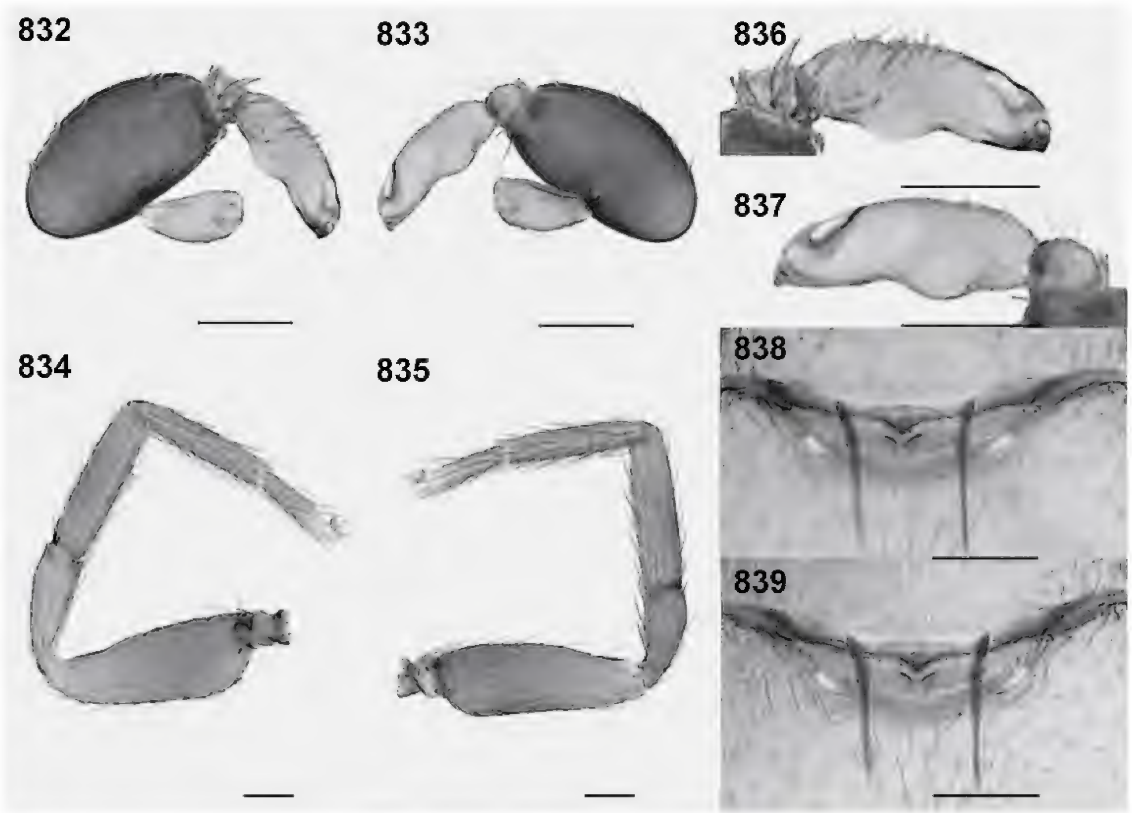


Figs. 819–827. *Opopaea tsimbazaza,* n. sp. **819.** Female, habitus, dorsal view. **820.** Habitus, ventral view. **821.** Abdomen, ventral view. **822.** Male, habitus, dorsal view. **823.** Ventral view. **824.** Abdomen, ventral view. **825.** Habitus, lateral view. **826.** Abdomen, lateral view. **827.** Anterior view. Scale bars: 0.2 mm.

Figs. 828–831. *Opopaea tsimbazaza,* n. sp., female. **828.** Carapace, anterior view. **829.** Lateral view. **830.** Dorsal view. **831.** Ventral view. Scale bars: 0.2 mm.

DISTRIBUTION: *O. tsimaloto* has been recorded from the northwest, southwest, and central western parts of Madagascar in the provinces of Mahajanga, Toliara, and Antananarivo (Ankarafantsika, Ankoririka, Kirindy, Ambohitantely) (map 5).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Mahajanga:** PN Ankarafantsika, Ampijoroa Station Forestière, 40 km 306° NW Andranofasika, S16°19′15″, E46°48′38″, 130 m elevation, 26 March–01 April 2001, tropical dry forest, EF19 sifted litter, coll. Fisher and Griswold et al., BLF3522 (CASC PBI_OON 3659), 2♂, 4♀. Forêt de Tsimaloto, 18.3 km 46° NE de Tsaramandroso, S16°13′41″, E46°8′37″, 135 m elevation, 2–8 April 2001, tropical dry forest, EF19 sifted litter, coll. Fisher et al. (CASC PBI_OON 3658), 10♂, 17♀. Réserve d'Ankoririka, 10.6 km 13° NE de Tsaramandroso, S16°16′2″, E46°2′55″, 210 m elevation, 9–14 April 2001, tropical dry forest, EF19 sifted litter, coll. Fisher et al. (CASC PBI_OON 3739), 1♀. **Toliara:** PN de Kirindy Mite, 16,3 km 127° SE Belo sur Mer, S20°47′43″, E44°8′49″, 80 m elevation, 06–10 December 2001, tropical dry forest, EF19 sifted litter (leaf mold, rotten wood), coll. Fisher et al. (CASC PBI_OON 3659), 3♀. 18 km NNW Betroka, S23°09′48″, E45°58′07″, 825 m



Figs. 832–839. *Opopaea tsimbazaza,* n. sp. **832.** Male, palp, prolateral view. **833.** Retrolateral view. **834.** Leg IV, prolateral view. **835.** Retrolateral view. **836.** Male, palp, close up, prolateral view. **837.** Retrolateral view. **838.** Epigynum, ventral view. **839.** Dorsal view. Scale bars: figures 834, 835 = 0.2 mm; others = 0.1 mm.

elevation, 09–14 December 1994, flight intercept traps, M. Ivie and A. Pollock (CASC PBI_OON 3596), 1♀. **Antananarivo:** Réserve spéciale d'Ambohitantely, forêt d'Ambohitantely, 20.9 km 72° NE d'Ankazobe, S18°13′31″, E47°17′13″, 1410 m elevation, 17–22 April 2001, montane rainforest, EB09 sifted litter, coll. Fisher and Griswold et al., BLF3694 (CASC PBI_OON 3128), 5♂, 2♀.

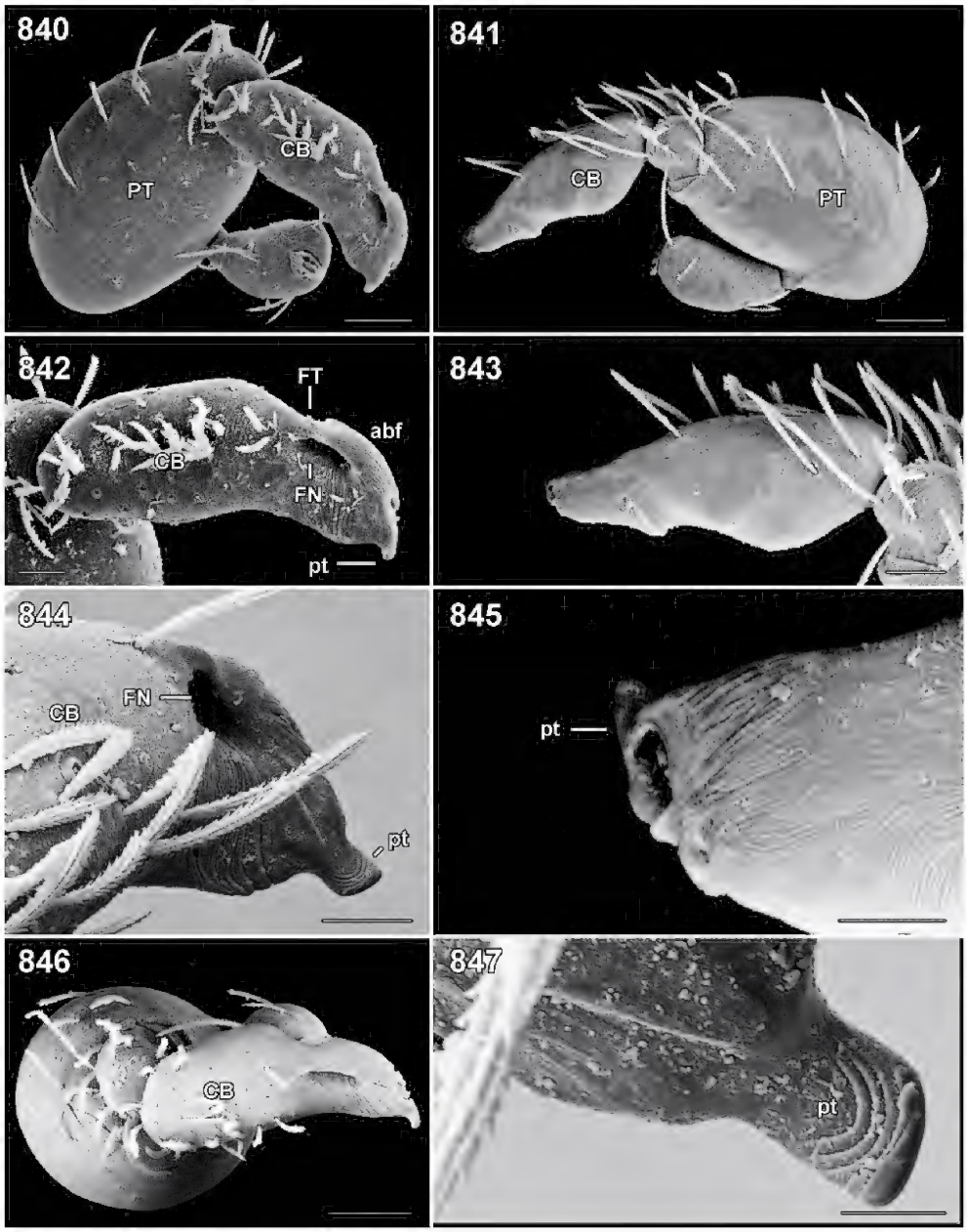
Opopaea tsimbazaza, new species
Figures 816–847; map 2

TYPES: Male holotype and female allotype from Antananarivo province, Tsimbazaza, 18.93036°S, 47.52693°E, general collecting, 13 October 1947, Paulian (MRAC PBI_OON 00035121).

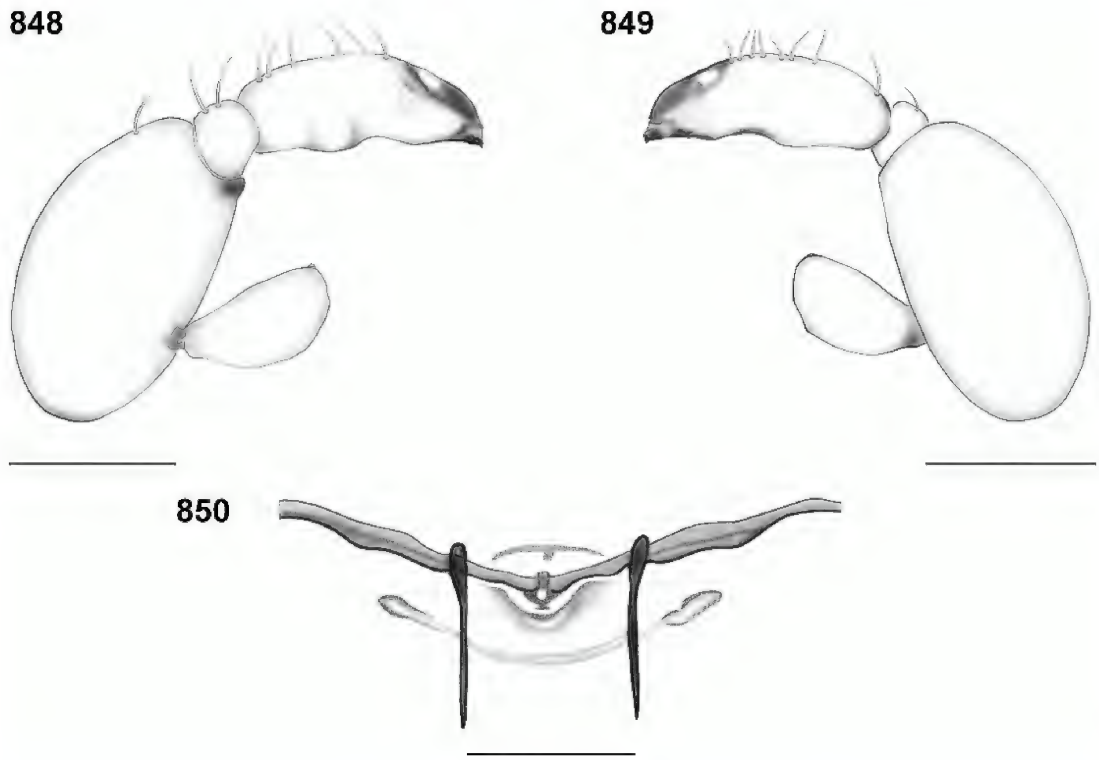
ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. tsimbazaza* can be most easily distinguished from those of other *Opopaea* species by a cymbiobulbus with a round anterior margin, which has a very thin and compact tip directed downward and bearing above it a round hole on prolateral side (figs. 832, 833, 836, 837, 840, 842, 844). Females of *O. tsimbazaza* can easily be recognized by a very short and narrow postgynum depression and a scutal ridge that together form an inverted triangle; the postgynum depression is sclerotized but abruptly interrupted medially, and the scutal ridge bears above its median surface a very distinct round parmula (figs. 818, 838, 839).

DESCRIPTION: Male (holotype) (PBI_OON 35121). Medium-sized species. Total length 1.59. Color: orange to yellowish orange. Carapace: pars cephalica not elevated with



Figs. 840–847. *Opopaea tsimbazaza,* n. sp., male palp. **840.** Prolateral view. **841.** Retrolateral view. **842, 844.** Close up, prolateral view. **843, 845.** Retrolateral view. **846.** Anterior view. **847.** Embolar region, anterior view. Scale bars: figures 840, 841, 846 = 40 μm; figures 842, 843 = 20 μm; figures 844–846 = 10 μm; others = 4 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FN,** fenestra; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.



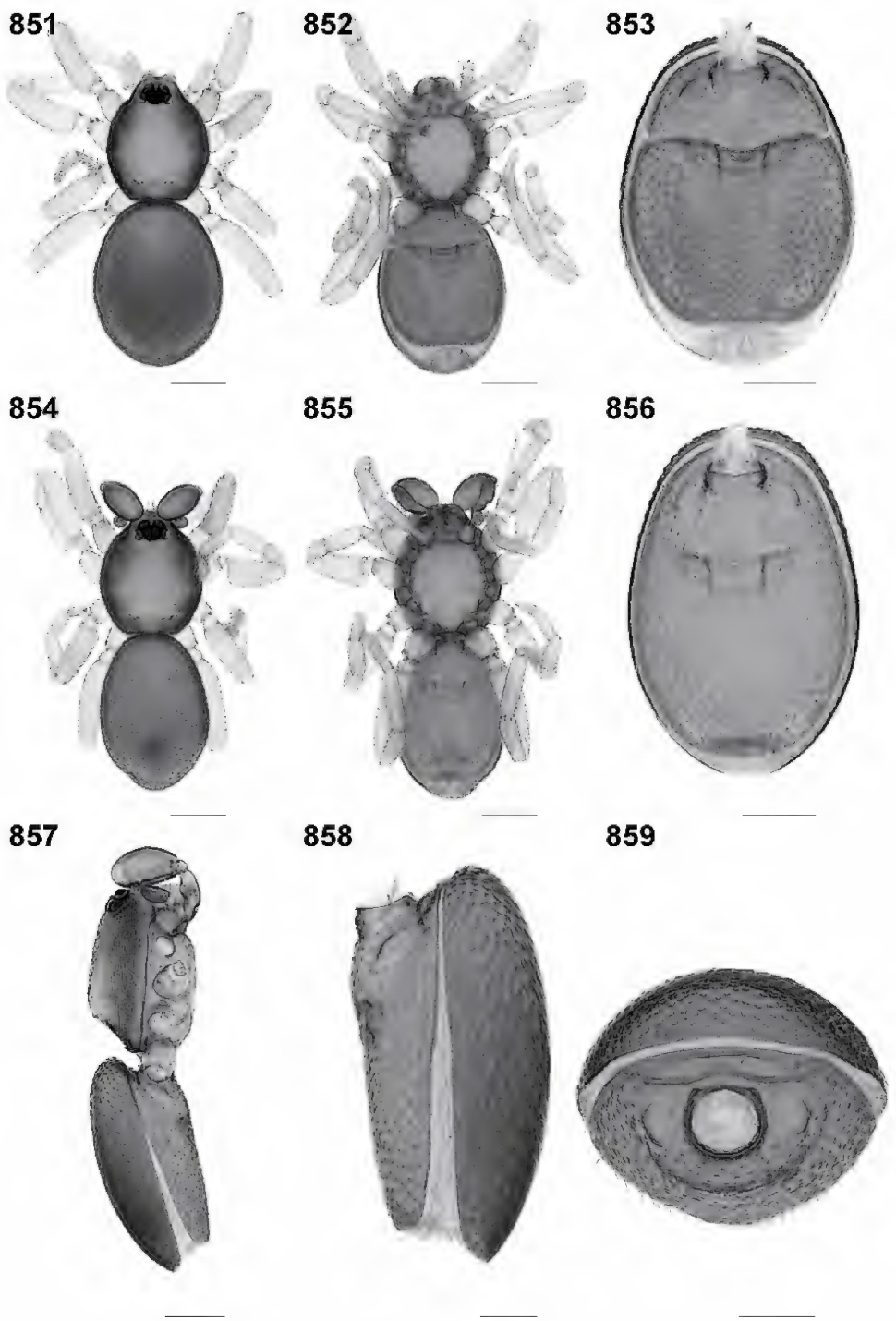
Figs. 848–850. *Opopaea tsimembo,* n. sp. **848.** Male, palp, prolateral view. **849.** Retrolateral view. **850.** Epigynum, dorsal view. Scale bars: 0.1 mm.

one row of two widely separated sets of two denticles bearing long thick hairs (figs. 829, 830), carapace anteriorly narrowed to less than one third maximum width. Carapace anterolateral corners without sclerotized triangular extension. Clypeus very low, not rebordered. Chilum absent. Eyes large. ALE largest. ALE and PME oval, PLE circular; PME darkened compared to other eyes, posterior eye row straight viewed from above, procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface hairy, without pits, shape of posterior part between coxae IV wide, hexagonal, not constricted. Lateral margins of area between coxae III unmodified, without posterior lumps; setae sparse, dark, needlelike, evenly distributed, originating from surface, without hair tufts (figs. 828–831). Palp posterior margin straight and with one smooth proximal protuberance. Palpal femora half the size of palpal patella and inserted in the middle of the patella. Palpal fenestra large and enlarged anteriorly, very close to palp tip, fenestral anterior top slightly elevated (figs. 816, 817, 832, 833, 836, 837, 840–847).

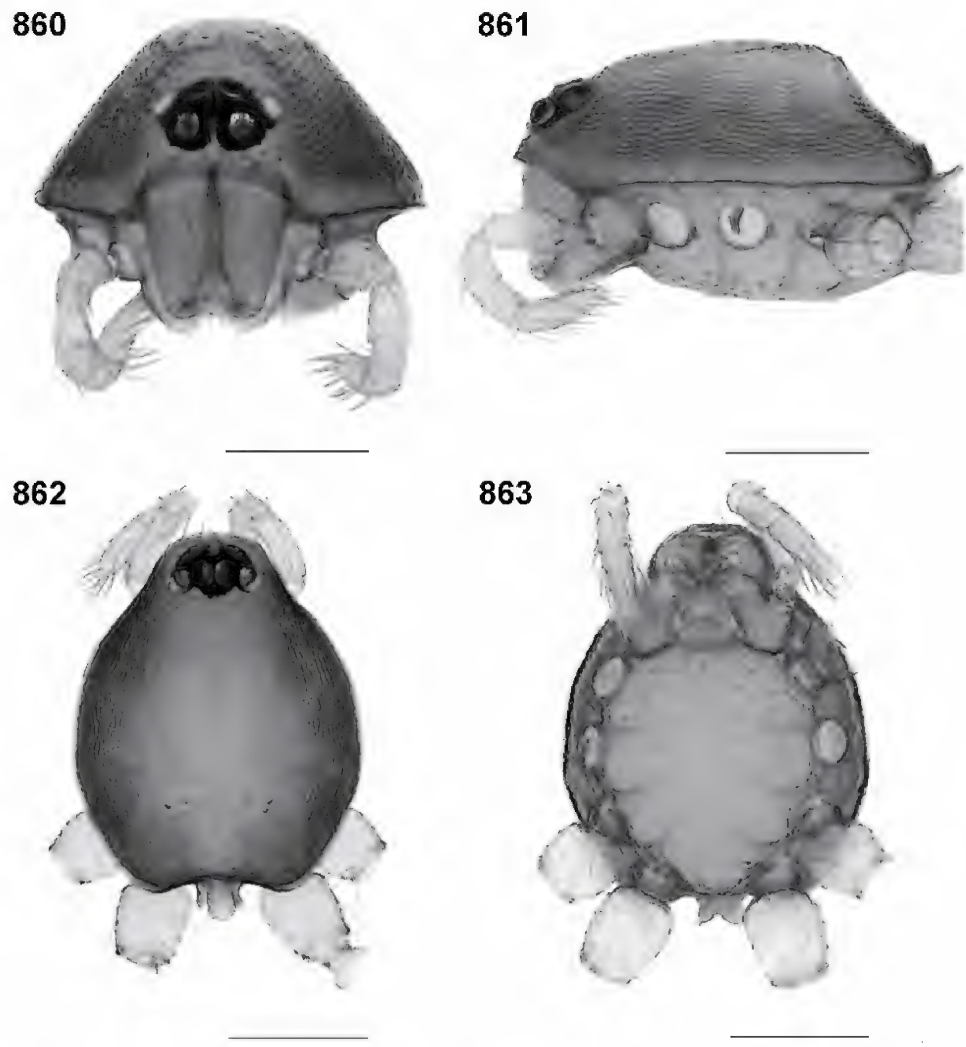
Female (allotype) (PBI_OON 35121). Total length 1.71. Abdomen round, not flattened with ventral scutum squared at posterior end (figs. 819–821). Epigynum scutal ridge thin, weakly sclerotized except medially (figs. 818, 838, 839).

MEASUREMENTS: Male (holotype) (PBI_OON 00035121) TL: 1.59; CL: 0.65; CW: 0.52; CH: 0.26; AL: 0.95; AW: 0.62; ALE: 0.09; PME: 0.07; PLE: 0.06; EGW: 0.19; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PME-PLE: 0; CBL: 0.20; CBW: 0.08; CBL/PTL: 0.74; FI: 0.13.

Female (allotype) (PBI_OON 35121) TL: 1.71; CL: 0.64; CW: 0.54; CH: 0.27; AL: 1.02; AW: 0.76; ALE: 0.09; PME: 0.08; PLE: 0.07;



Figs. 851–859. *Opopaea tsimembo,* n. sp. **851.** Female, habitus, dorsal view. **852.** Habitus, ventral view. **853.** Abdomen, ventral view. **854.** Male, habitus, dorsal view. **855.** Habitus, ventral view. **856.** Abdomen, ventral view. **857.** Habitus, lateral view. **858.** Abdomen, lateral view. **859.** Anterior view. Scale bars: 0.2 mm.



Figs. 860–863. *Opopaea tsimembo,* n. sp., female. **860.** Carapace, anterior view. **861.** Lateral view. **862.** Dorsal view. **863.** Ventral view. Scale bars: 0.2 mm.

EGW: 0.21; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PME-PLE: 0.01; EFL: 0.16; LAL: 0.07; PGI (LAL/EFL): 0.43; PDL/LAL: 0.57; PDW/EFL: 0.37.

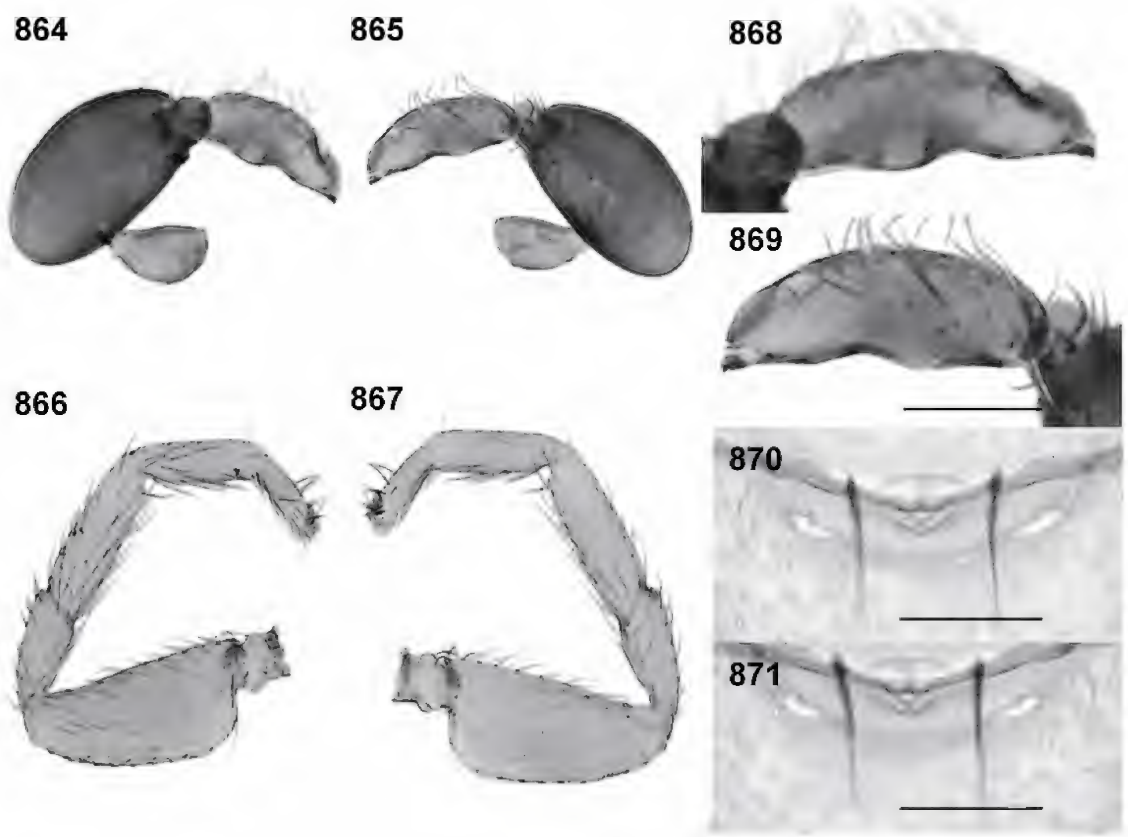
VARIATION: Male: TL: 1.29–1.59; CL: 0.57–0.65; CW: 0.46–0.52; AL: 0.70–0.95; AW: 0.48–0.62.

Female: TL: 1.67–1.71; CL: 0.63–0.65; CW: 0; AL: 1.02–1.08; AW: 0.74–0.76.

NATURAL HISTORY: *O. tsimbazaza* was mostly collected in secondary forest at high elevation.

DISTRIBUTION: *O. tsimbazaza* was mostly found in the center of Madagascar in the province of Antananarivo (Park Tsimbazaza, Ambohimanga forest) (map 2).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Antananarivo:** Tsimbazaza, S18.93036°, E47.52693°, general collecting, November 1946, C.J. Millot (MRAC PBI_OON 34310), 1♂, 5♀ (MRAC PBI_OON 00035121), 4♂, 3♀ (MRAC PBI_OON 00034307), 1♀ (MRAC PBI_OON 00034308), 1♀ (MRAC PBI_OON 00035119), 1♂, 4♀. Ambohimanga,



Figs. 864–871. *Opopaea tsimembo,* n. sp. **864.** Male, palp, prolateral view. **865.** Retrolateral view. **866.** Leg IV, prolateral view. **867.** Retrolateral view. **868.** Male, palp, close up, prolateral view. **869.** Retrolateral view. **870.** Epigynum, ventral view. **871.** Dorsal view. Scale bars: figures 866, 867 = 0.2 mm; others = 0.1 mm.

S20.866667°, E47.6°, general collecting, December 1946, C.J. Millot (MRAC PBI_OON 35121), 1♀.

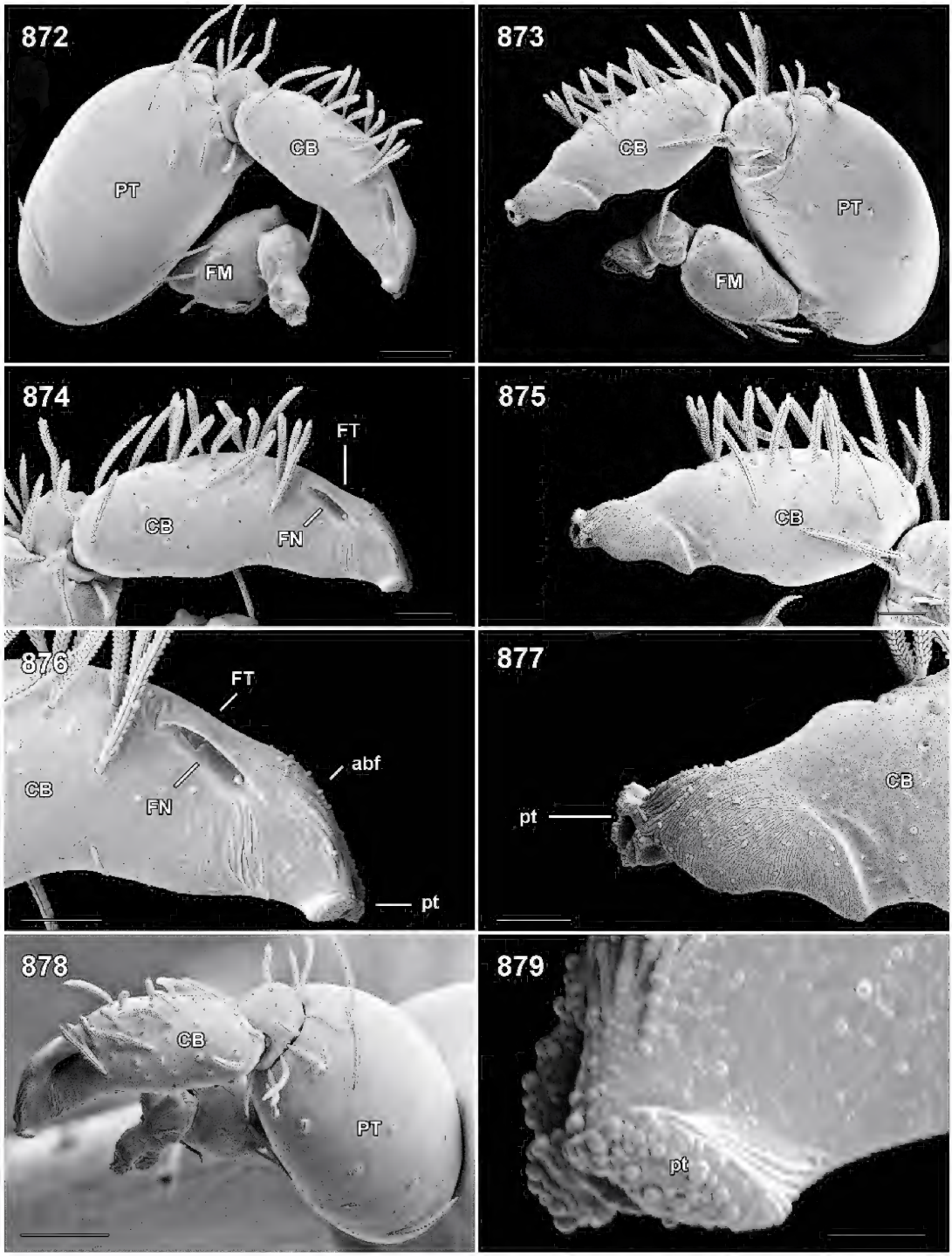
Opopaea tsimembo, new species
Figures 6, 51, 53, 88, 848–879; map 5

TYPES: Male holotype and female allotype from Mahajanga: Park National d'Ankarafantsika, Forêt de Tsimembo, 18.3 km 46° NE de Tsaramandroso, 16°13′41″S, 46°8′37″E, 135 m, sifted litter, tropical dry forest, 02–08 April 2001, coll. Fisher and Griswold, et al. (CASC PBI_OON 35066).

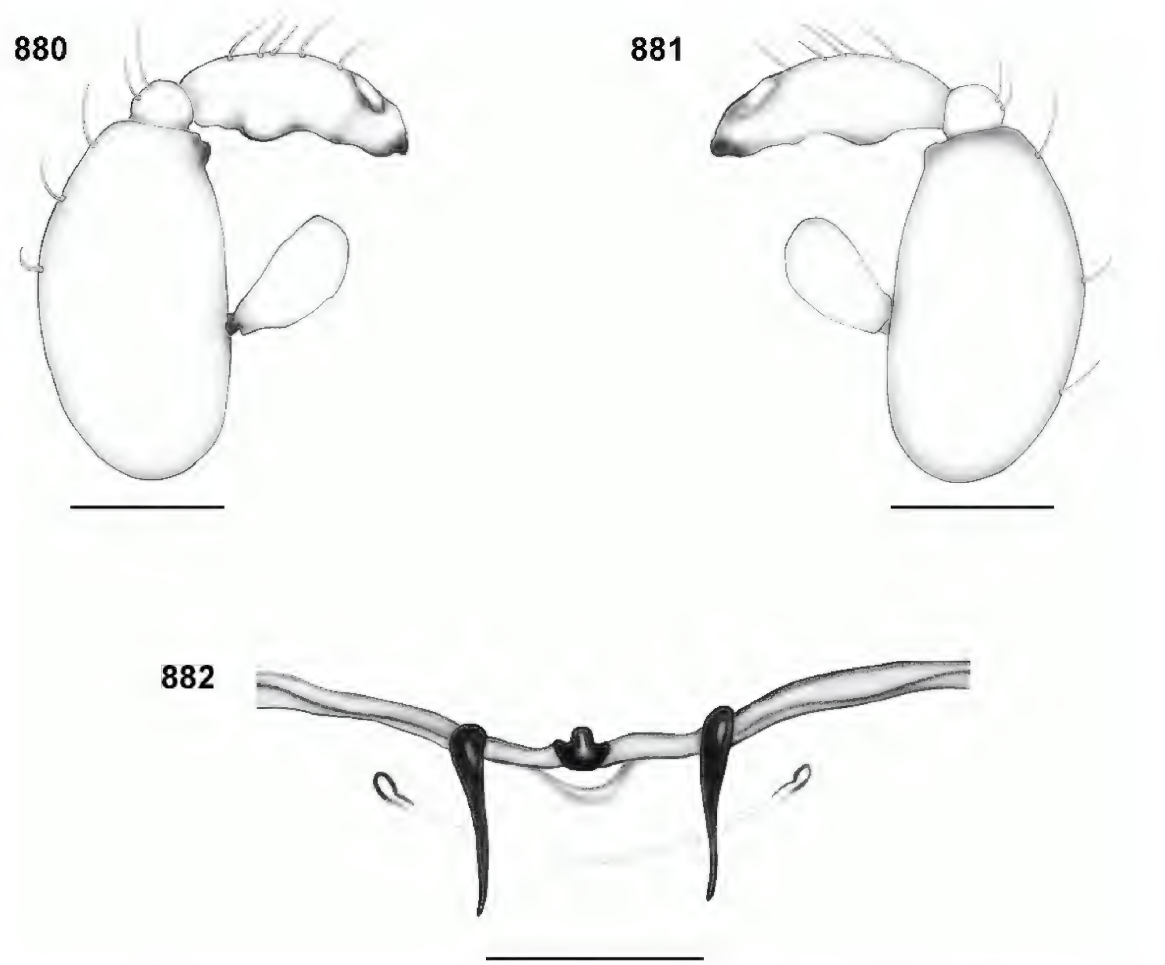
ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. tsimembo* can be most easily distinguished from those of other *Opopaea* species in having the area before fenestra very thick and sclerotized all the way to the tip and by the small, short, beaklike sclerotized tip (figs. 848, 849, 864, 865, 868, 869, 872–879). Females of *O. tsimembo* can be easily recognized by the existence of a second small circular sclerotized depression between the postgynum depression and the epigastric furrow (figs. 850, 870, 871).

DESCRIPTION: Male (holotype) (PBI_OON 35066). Small to medium-sized species. Total length 1.35. Color: orange. Carapace: pars cephalica slightly elevated posteriorly with one row of two sets of three denticles (figs. 861, 862). Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent, undivided. Cheliceral paturon straight. Eyes small. ALE and PME largest. ALE oval, PME and PLE circular; PME darkened compared to other eyes, posterior eye row



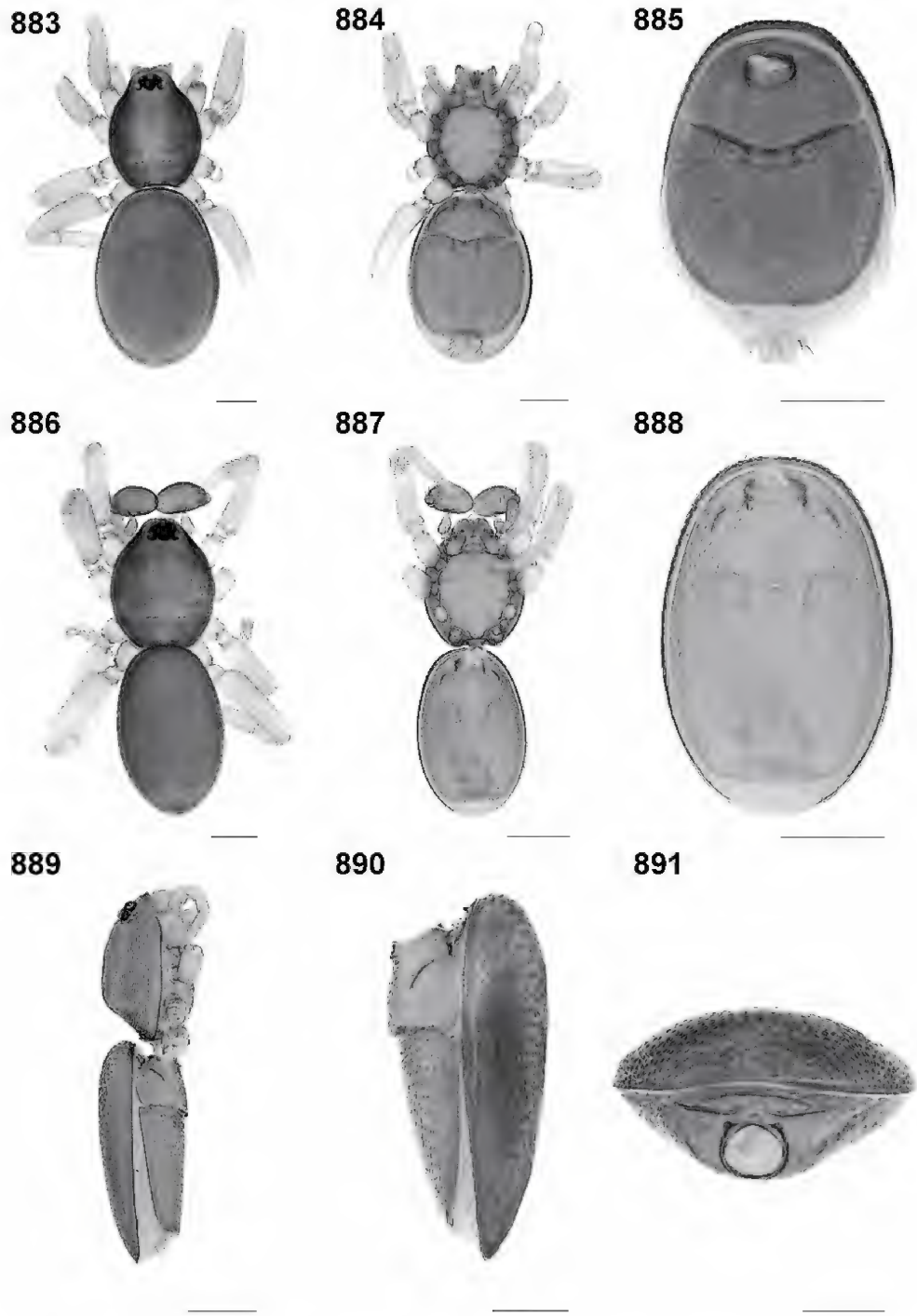
Figs. 872–879. *Opopaea tsimembo,* n. sp male palp. **872.** Prolateral view. **873.** Retrolateral view. **874, 876.** Close up, prolateral view. **875, 877.** Retrolateral view. **878.** Anterior view. **879.** Embolar region, prolateral view. Scale bars: figures 872–873 = 30 μm; figures 874–877 = 20 μm; figure 878 = 40 μm; figure 879 = 3 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FN,** fenestra; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.



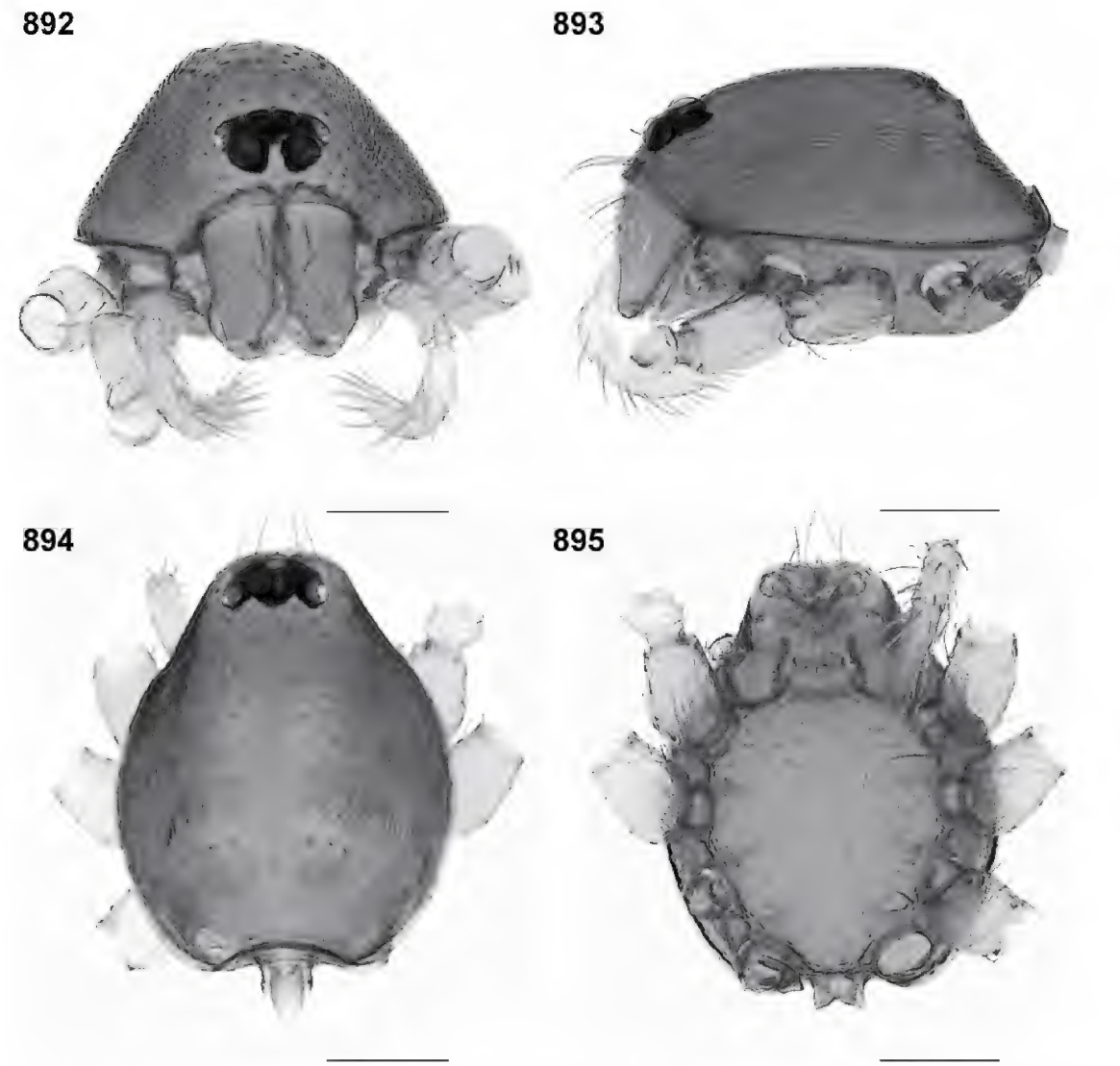
Figs. 880–882. *Opopaea tsingy,* n. sp. **880.** Male, palp, prolateral view. **881.** Retrolateral view. **882.** Epigynum, dorsal view. Scale bars: 0.1 mm.

straight viewed from above, slightly procurved from front; ALE separated by more than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, shape of posterior part between coxae IV wide and hexagonal, not constricted. Lateral margins of area between coxae III unmodified, without lumps; setae parse but evenly distributed, originating from surface, without hair tufts (figs. 860–863). Cymbiobulbus shorter than the patella. Posterior margin of cymbiobulbus more or less straight with only one smooth proximal protuberance. Palpal fenestra large but not enlarged posteriorly, fenestra top flat, area before fenestra not raised into a dome. Femora half the size of palpal patella and inserted at about one third the length of the patella (figs. 848, 849, 864, 865, 868, 869, 872–879).

Female (allotype) (PBI_OON 35066). Total length 1.56. Orange, abdomen oval and not flattened posteriorly. Postgynum depression arclike, about one third longer than the distance between epigastric furrow and the shallow groove connecting tracheal spiracles and one third wider than the distance between the two lateral apodemes, ridge sclerotized. Scutal ridge weakly sclerotized bearing a small cylindrical parmula in its median (figs. 850, 870, 871).



Figs. 883–891. *Opopaea tsingy,* n. sp. **883.** Female, habitus, dorsal view. **884.** Habitus, ventral view. **885.** Abdomen, ventral view. **886.** Male, habitus, dorsal view. **887.** Habitus, ventral view. **888.** Abdomen, ventral view. **889.** Habitus, lateral view. **890.** Abdomen, lateral view. **891.** Anterior view. Scale bars: 0.2 mm.



Figs. 892–895. *Opopaea tsingy,* n. sp., female. **892.** Carapace, anterior view. **893.** Lateral view. **894.** Dorsal view. **895.** Ventral view. Scale bars: 0.2 mm.

MEASUREMENTS: Male (holotype) (PBI_OON 35066). TL: 1.35; CL: 0.61; CW: 0.50; CH: 0.28; AL: 0.8; AW: 0.50; ALE: 0.06; PME: 0.06; PLE: 0.06; EGW: 0.17; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.01; CBL: 0.19; CBW: 0.07; CBL/PTL: 0.79; FI: 0.10.

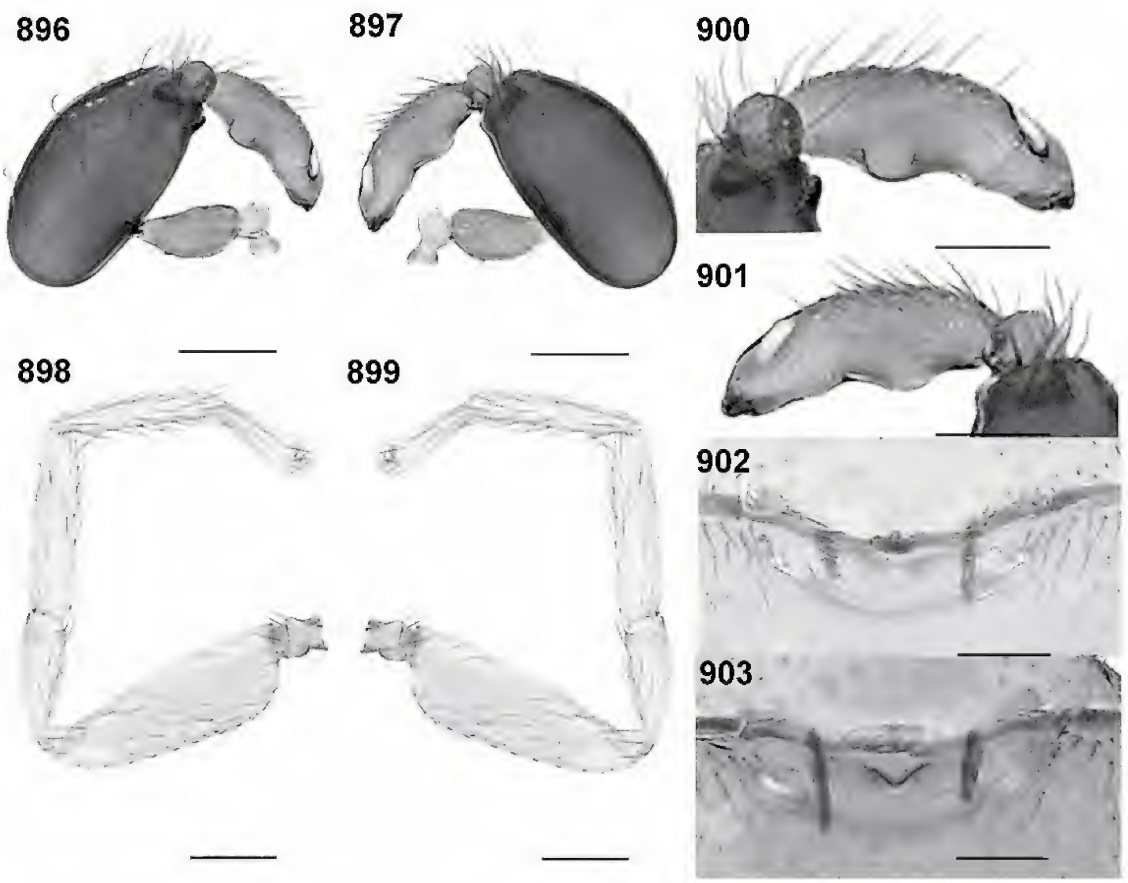
Female (allotype) (PBI_OON 35066). TL: 1.56; CL: 0.64; CW: 0.51; CH: 0.26; AL: 0.97; AW: 0.65; ALE: 0.06; PME: 0.06; PLE: 0.05; EGW: 0.18; ALE-ALE: 0.04; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0.01; EFL: 0.15; LAL: 0.07; PGI (LAL/EFL): 0.46; PDL/LAL: 0.42; PDW/EFL: 0.40.

VARIATION: Male: TL: 1.35–1.41; CL: 0.61–0.65; CW: 0.50–0.50; AL: 0.80–1.82; AW: 0.50–0.54.

Female: TL: 1.54–1.57; CL: 0.64–0.66; CW: 0.51–0.54; AL: 0.94–0.97; AW: 0.65–0.69.

NATURAL HISTORY: *O. andranomay* is found in tropical dry forests at low elevation (135 m).

DISTRIBUTION: *O. tsimembo* is found in northwestern Madagascar in the province of



Figs. 896–903. *Opopaea tsingy,* n. sp. **896.** Male, palp, prolateral view. **897.** Retrolateral view. **898.** Leg IV, prolateral view. **899.** Retrolateral view. **900.** Male, palp, close up, prolateral view. **901.** Retrolateral view. **902.** Epigynum, ventral view. **903.** Dorsal view. Scale bars: figures 898, 899 = 0.2 mm; others = 0.1 mm.

Mahajanga (Park National d'Ankarafantsika, Forêt de Tsimembo) (map 5).

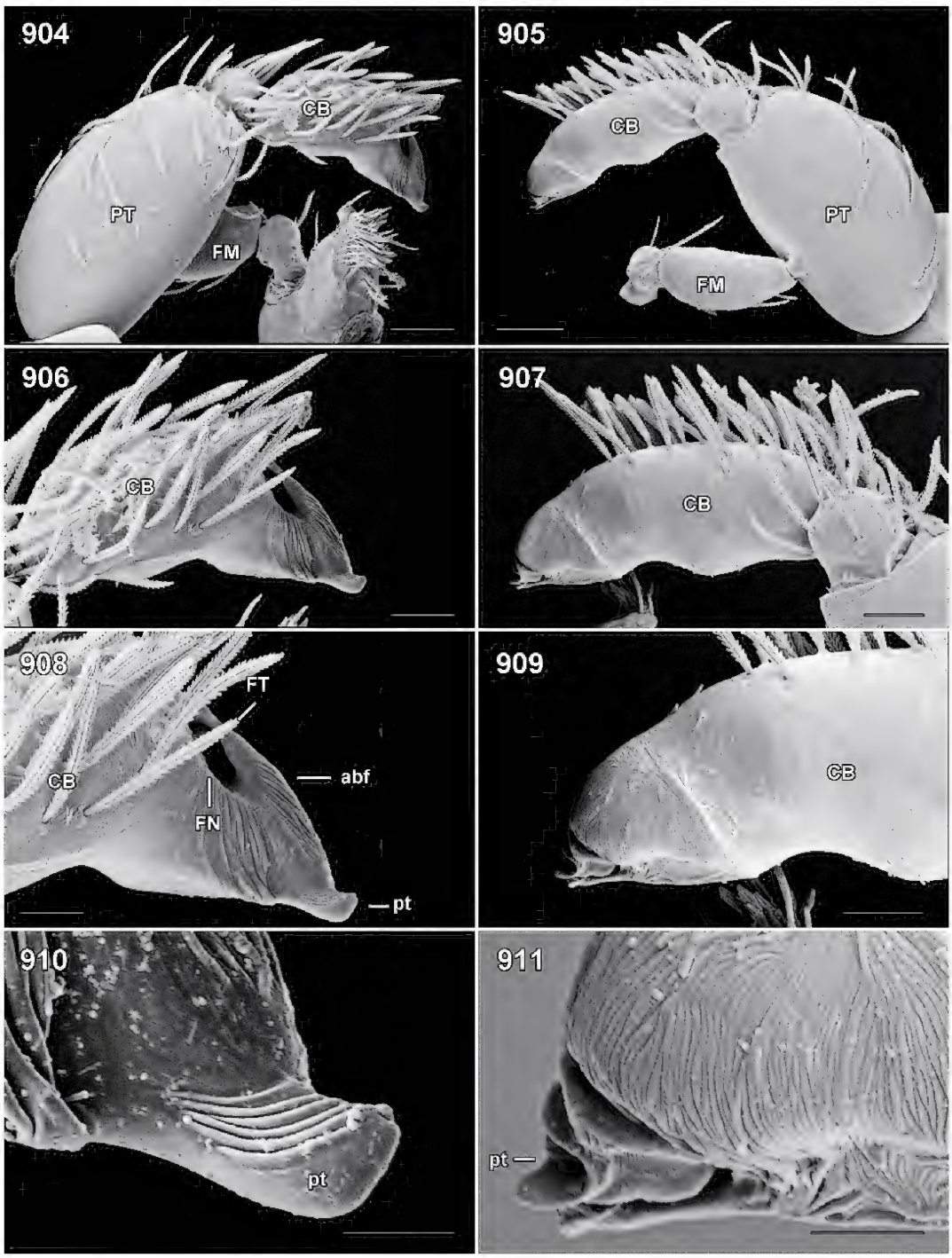
OTHER MATERIAL EXAMINED: MADAGASCAR: **Mahajanga:** Park National d'Ankarafantsika, Forêt de Tsimembo, 18.3 km 46° NE de Tsaramandroso, 16°13′41″S, 46°8′37″E, 135 m, sifted litter, tropical dry forest, 02–08 April 2001, coll. Fisher and Griswold et al., 3♂, 16♀ (CASC PBI_OON 35066).

Opopaea tsingy, new species
Figures 880–911; map 4

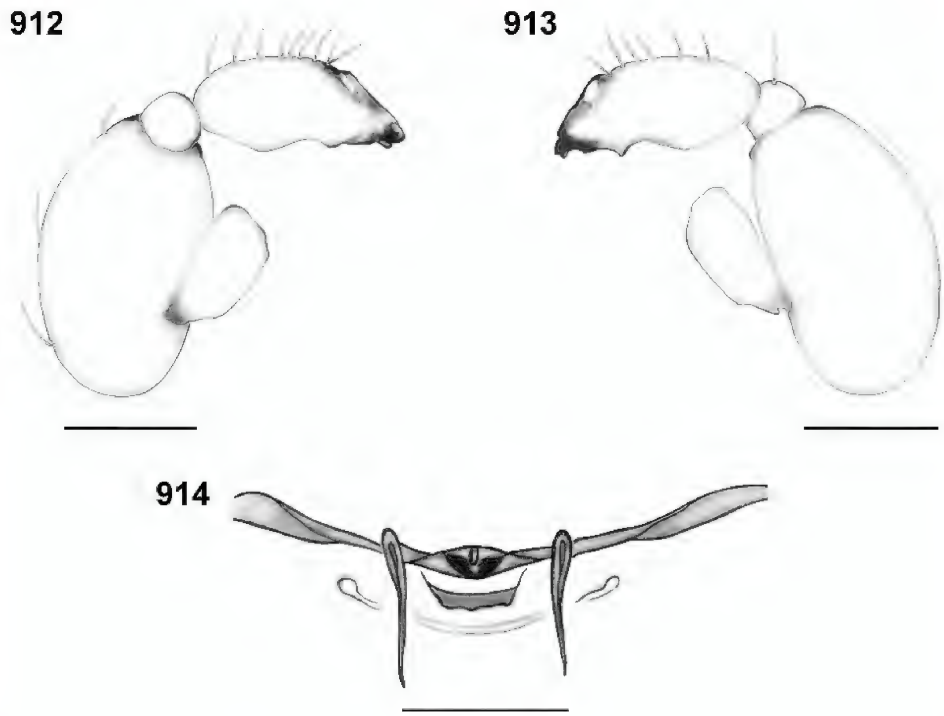
TYPES: Male holotype and female allotype from Mahajanga: PN Tsingy de Bemaraha, 2.5 km 62° ENE Bekopaka, Ankidrodroa River, 19°7′56″S, 44°48′53″E, 100 m elevation, 11–15 November 2001, tropical dry forest on Tsingy, EF19 sifted litter (leaf mold, rotten wood), coll. B.L. Fisher et al. (CASC PBI_OON 3792), 1♂, 7♀.

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. tsingy* resemble those of *O. namoroka* in having the tip of the cymbiobulbus short, sharp, and with a sclerotized compact extension, but can be distinguished by having the tip extension not folded, but longer and pointing more or less forward. The fenestra is also larger and more or less circular (figs. 880, 881, 896, 897, 900, 901, 904–911). Females of *O. tsingy* can be recognized by the weakly sclerotized scutal ridge, medially bearing a thickened arclike structure with a small, thin, and cylindrical



Figs. 904–911. *Opopaea tsingy,* n. sp., male palp. **904.** Prolateral view. **905.** Retrolateral view. **906, 908.** Close up, prolateral view. **907, 909.** Retrolateral view. **910.** Embolar region, prolateral view. **911.** Retrolateral view. Scale bars: figures 904, 905 = 30 μm; figures 906, 907 = 15 μm; figures 908, 909 = 10 μm; others = 6 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FN,** fenestra; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.



Figs. 912–914. *Opopaea tsinjoriaky,* n. sp. **912.** Male, palp, prolateral view. **913.** Retrolateral view. **914.** Epigynum, dorsal view. Scale bars: 0.1 mm.

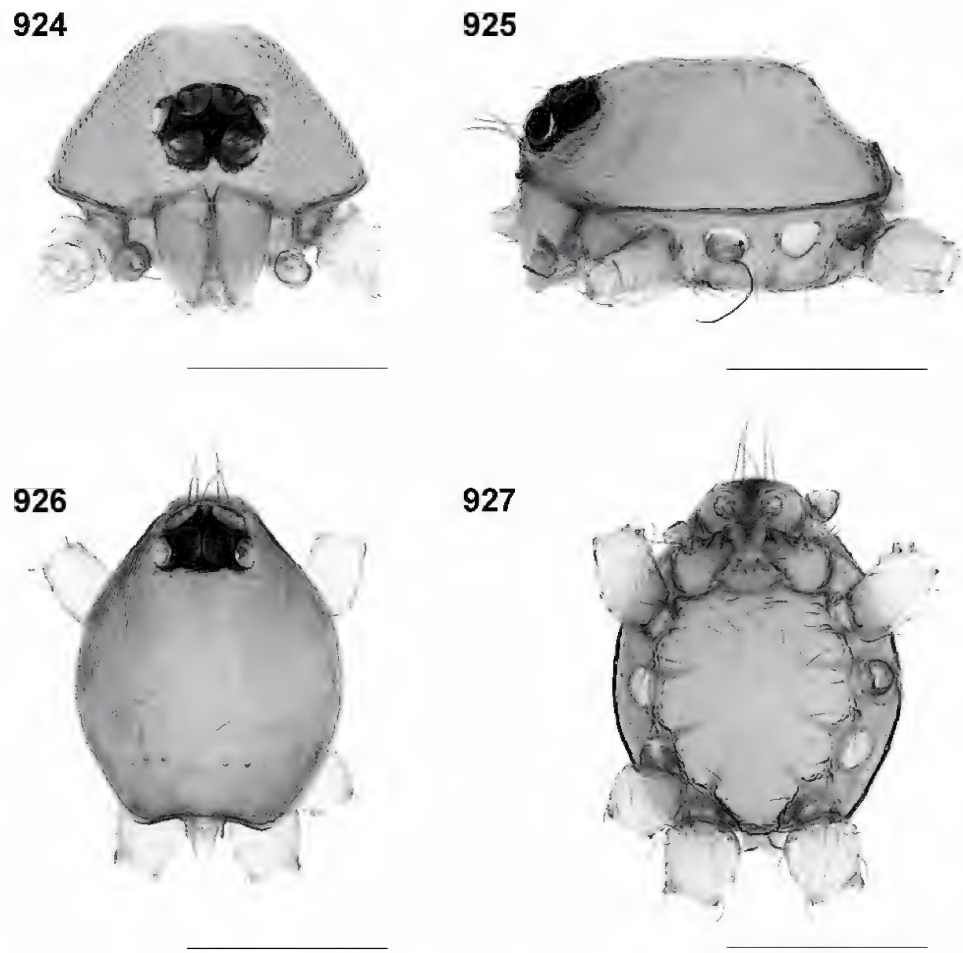
parmula on its upper surface (figs. 882, 902, 903).

DESCRIPTION: Male (holotype) (PBI_OON 3792). Small species. Total length 1.47. Color: dark orange. Carapace: pars cephalica flat with two sets of three separated denticles, carapace anteriorly narrowed to less than one third its maximum width. Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes small. ALE largest. ALE oval, PME and PLE circular; PME darkened compared to other eyes, posterior eye row straight viewed from above, straight from front; ALE separated by their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface without pits, shape of posterior part between coxae IV wide, hexagonal, and not constricted. Lateral margins between coxae III unmodified, without lumps, setae sparse, dark, needlelike, and densest laterally, originating from surface, without hair tufts (figs. 891–894). Cymbiobulbus elongated with posterior margin straight and with three protuberances, a large smooth proximal one and a tiny, sharp, and sclerotized distal one with a bulge in the median part of the prolateral side of the cymbiobulbus. Palpal femora half the size of palpal patella and inserted in the middle of the thick patella. Palpal fenestra narrow and elliptical, located at one third the length of the palpal tip, fenestral anterior top not elevated (figs. 880–882, 896, 897, 900, 901, 904–911).

Female (allotype) (PBI_OON 3792). Total length 1.68. Abdomen round and flattened with ventral scutum round at posterior end in females. Postgynum depression very short and slitlike dorsally, but arclike and weakly sclerotized ventrally (figs. 882, 902, 903).

MEASUREMENTS: Male (holotype) (PBI_OON 3792). TL: 1.47; CL: 0.63; CW: 0.49; CH: 0.25; AL: 0.84; AW: 0.53; ALE: 0.07; PME: 0.06; PLE: 0.06; EGW: 0.17; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0;

Figs. 915–923. *Opopaea tsinjoriaky,* n. sp. **915.** Female, habitus, dorsal view. **916.** Habitus, ventral view. **917.** Abdomen, ventral view. **918.** Male, habitus, dorsal view. **919.** Habitus, ventral view. **920.** Abdomen, ventral view. **921.** Habitus, lateral view. **922.** Abdomen, lateral view. **923.** Abdomen, anterior view. Scale bars: 0.2 mm.



Figs. 924–927. *Opopaea tsinjoriaky,* n. sp., female. **924.** Carapace, anterior view. **925.** Lateral view. **926.** Dorsal view. **927.** Ventral view. Scale bars: 0.2 mm.

PME-PLE: 0.01; CBL: 0.21; CBW: 0.08; CBL/PTL: 0.75; FI: 0.15.

Female (allotype) (PBI_OON 3792). TL: 1.68; CL: 0.69; CW: 0.49; CH: 0.25; AL: 1.01; AW: 0.73; ALE: 0.05; PME: 0.05; PLE: 0.05; EGW: 0.17; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PME-PLE: 0.02; EFL: 0.15; LAL: 0.08; PGI (LAL/EFL): 0.53; PDL/LAL: 0.50; PDW/EFL: 0.40.

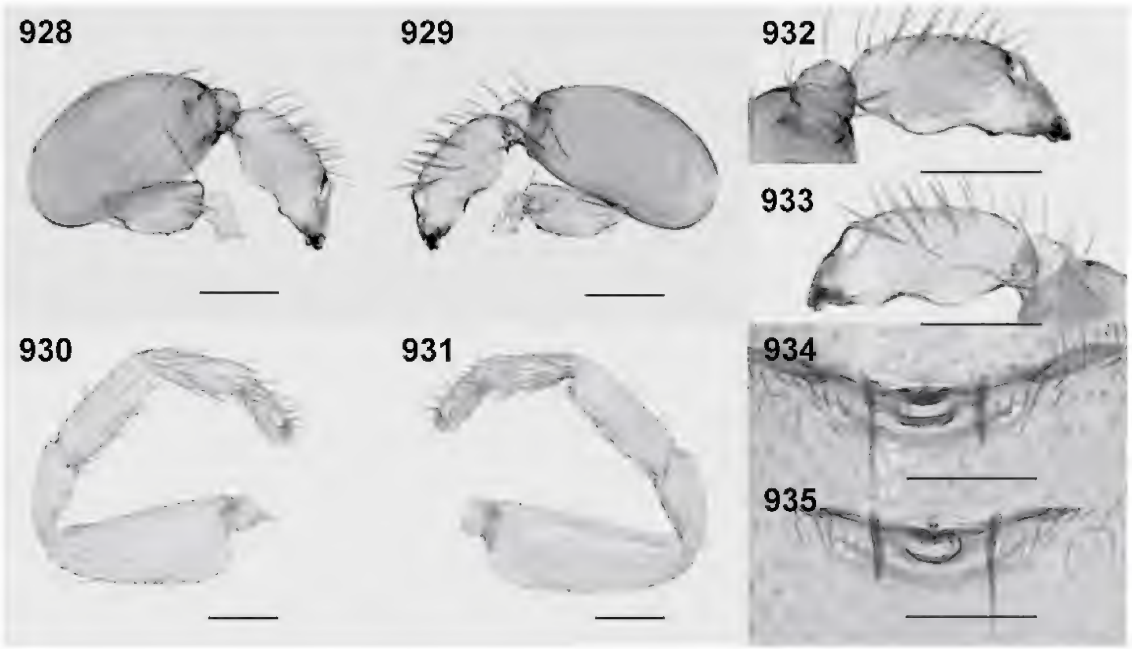
NATURAL HISTORY: *O. tsingy* was collected in a tropical dry forest at 100 m elevation.

DISTRIBUTION: *Opopaea tsingy* was found in northwestern Madagascar in the province of Mahajanga (Park National Tsingy de Bemaraha) (map 4).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Mahajanga:** PN Tsingy de Bemaraha, 2.5 km 62° ENE Bekopaka, Ankidrodroa River, S19°7′56″, E44°48′53″, 100 m elevation, 11–15 November 2001, tropical dry forest on Tsingy, EF19 sifted litter (leaf mold, rotten wood), coll. B.L. Fisher et al. (CASC PBI_OON 3792), 6♂, 7♀.

Opopaea tsinjoriaky, new species
Figures 43, 86, 912–945; map 2

TYPES: Male holotype and female allotype from Toliara province, Forêt de Tsinjoriaky, 6.2 km 84°E Tsitoha, 22°48′8″S, 43°25′14″E, 70 m, sifted litter (leaf mold, rotten wood),



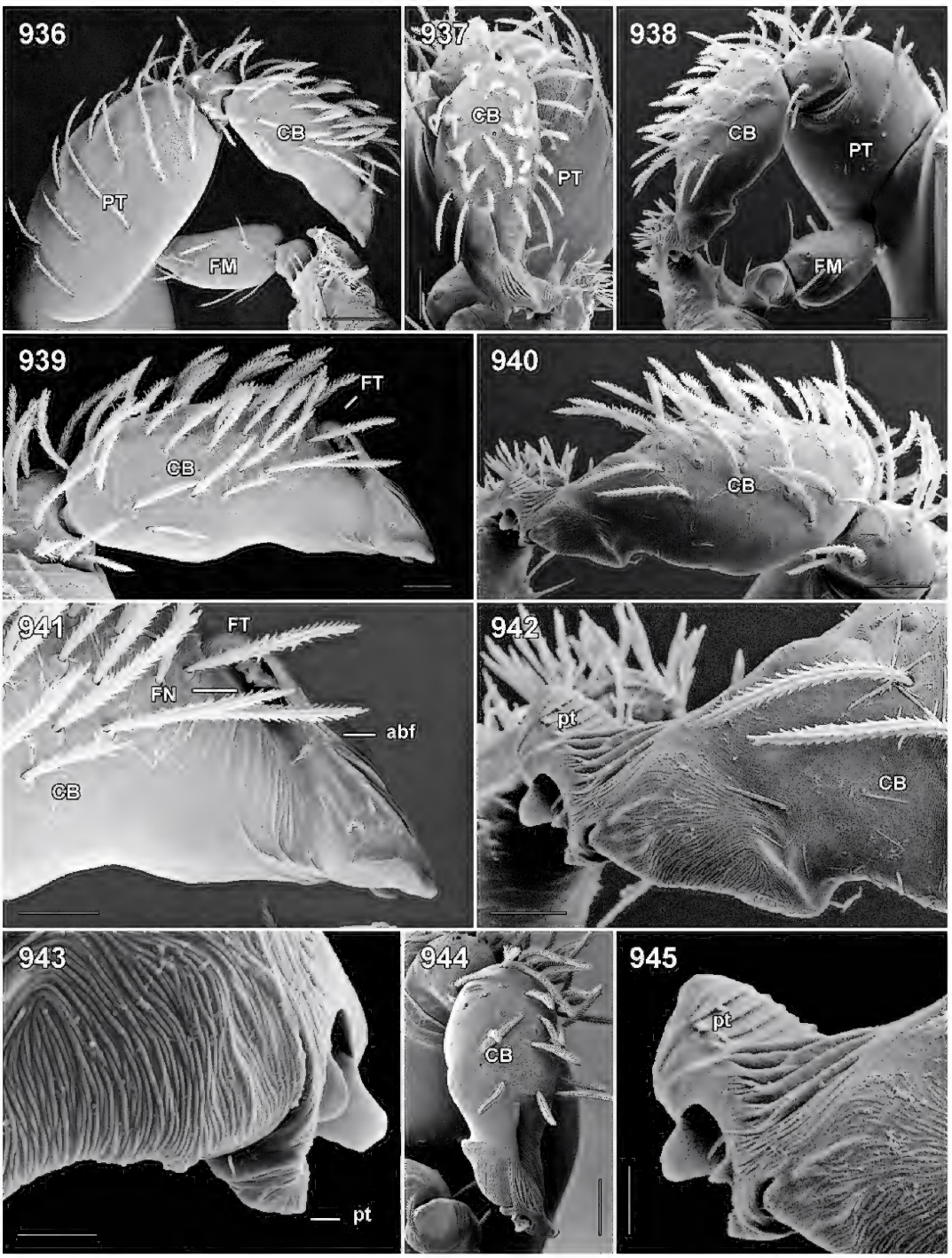
Figs. 928–935. *Opopaea tsinjoriaky*, n. sp. **928.** Male, palp, prolateral view. **929.** Retrolateral view. **930.** Leg IV, prolateral view. **931.** Retrolateral view. **932.** Male, palp, close up, prolateral view. **933.** Retrolateral view. **934.** Epigynum, ventral view. **935.** Dorsal view. Scale bars: figures 930, 931 = 0.2 mm; others = 0.1 mm.

spiny forest/thicket, 06–10 March 2002, coll. B.L. Fisher et al. (CASC PBI_OON 3771), 1♂, 1♀.

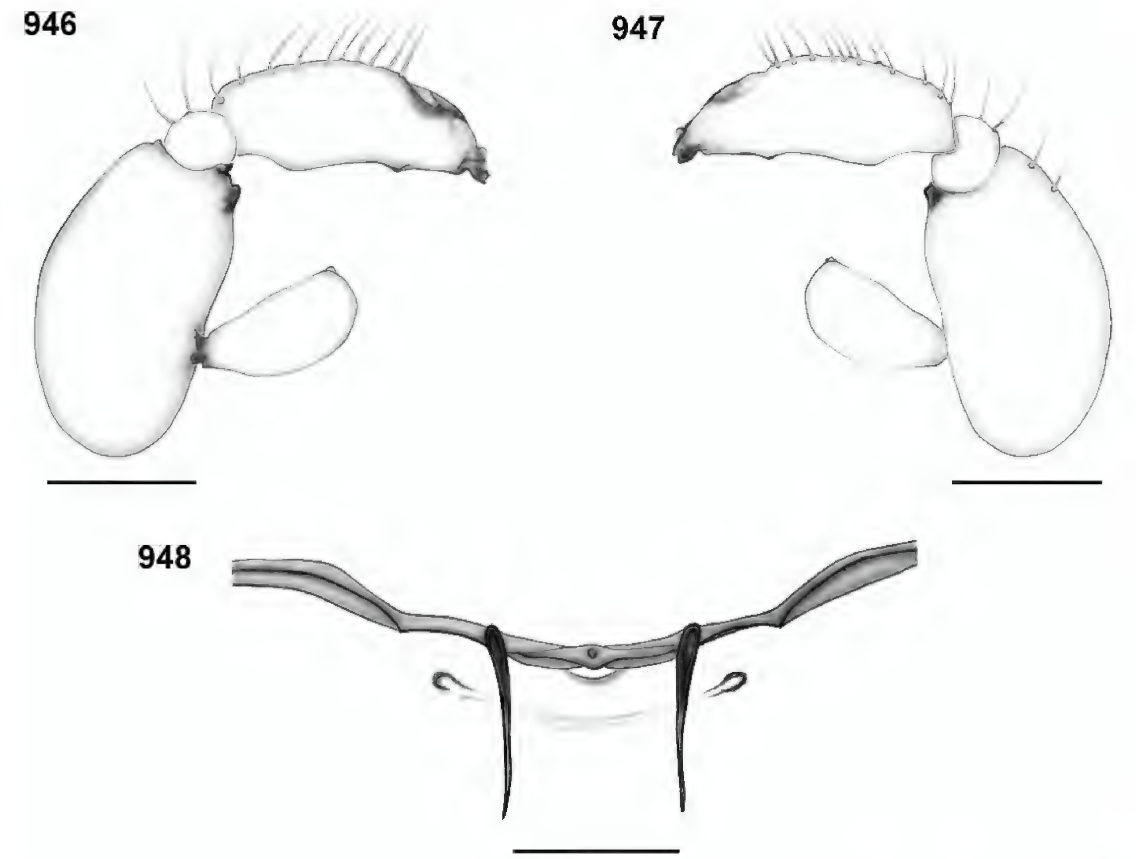
ETYMOLOGY: The species epithet is a name in apposition taken from the type locality.

DIAGNOSIS: Males of *O. tsinjoriaky* can be most easily distinguished from those of other *Opopaea* species by the shape of the cymbiobulbus, with the area above the fenestra raised and sloping steeply downward toward the tip, and by its tip having two large liplike extensions (figs. 912, 913, 928, 929, 932, 933, 936–945). Females of *O tsinjoriaky* can easily be recognized by a postgynum depression ridge extremely thick and sclerotized and a scutal ridge medially depressed thick and sclerotized bearing above it an elongated parmula (figs. 914, 934, 935).

DESCRIPTION: Male (holotype) (PBI_OON 3771). Small species. Total length 1.32. Color: orange. Carapace: pars cephalica not elevated with one row of two sets of three denticles bearing long hairs, carapace anteriorly narrowed to one third maximum width. Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes large. ALE and PME of the same size and largest. ALE and PLE oval, PME square; PME darkened compared to other eyes, posterior eye row straight viewed from above, procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface hairy, without pits, shape of posterior part between coxae IV hexagonal, slightly constricted. Lateral margins of area between coxae III unmodified, without lumps; setae sparse, dark, needlelike, evenly distributed, originating from surface, without hair tufts (figs. 920–923). Palp posterior margin straight and with two protuberances, a distal one smaller and more sharply pointed compared to the proximal one. Palpal femora half the size of palpal patella and inserted at one third the length of the patella. Palpal fenestra oval, located at one third the length of the palp, fenestral top raised, area before fenestra not raised into a dome but forming a



Figs. 936–945. *Opopaea tsinjoriaky,* n. sp., male palp. **936.** Prolateral view. **937, 944.** Anterior view. **938.** Retrolateral view. **939, 941.** Close up, prolateral view. **940, 942.** Retrolateral view. **943.** Embolar region, prolateral view. **945.** Retrolateral view. Scale bars: figures 936–938, 944 = 30 μm; figures 939–942 = 10 μm; others = 2 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FN,** fenestra; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.



Figs. 946–948. *Opopaea vohibazaha,* n. sp. **946.** Male, palp prolateral view. **947.** Retrolateral view. **948.** Epigynum, dorsal view. Scale bars: 0.1 mm.

straight, steep slope to the tip (figs. 912, 913, 928, 929, 932, 933, 936–945).

Female (allotype) (PBI_OON 3771). Total length 1.29. Abdomen oval, not flattened posteriorly with ventral scutum squared at posterior end. Epigynum postgynum depression two thirds as wide as the distance between the lateral apodemes and one half as long as the distance between epigastric furrow and the shallow groove connecting tracheal spiracles (figs. 914, 934, 935).

MEASUREMENTS: Male (holotype) (PBI_OON 3771). TL: 1.32; CL: 0.58; CW: 0.48; CH: 0.25; AL: 0.75; AW: 0.63; ALE: 0.09; PME: 0.09; PLE: 0.06; EGW: 0.19; ALE-ALE: 0.03; ALE-PLE: 0.02; PME-PME: 0; PME-PME: 0; CBL: 0.17; CBW: 0.08; CBL/PTL: 0.68; FI: 0.11.

Female (allotype) (PBI_OON 3771). TL: 1.28; CL: 0.55; CW: 0.49; CH: 0.22; AL: 0.92; AW: 0.67; ALE: 0.08; PME: 0.07; PLE: 0.05; EGW: 0.19; ALE-ALE: 0.03; ALE-PLE: 0.01; PME-PME: 0; PME-PME: 0; EFL: 0.13; LAL: 0.06; PGI (LAL/EFL): 0.46; PDL/LAL: 0.5; PDW/EFL: 0.76.

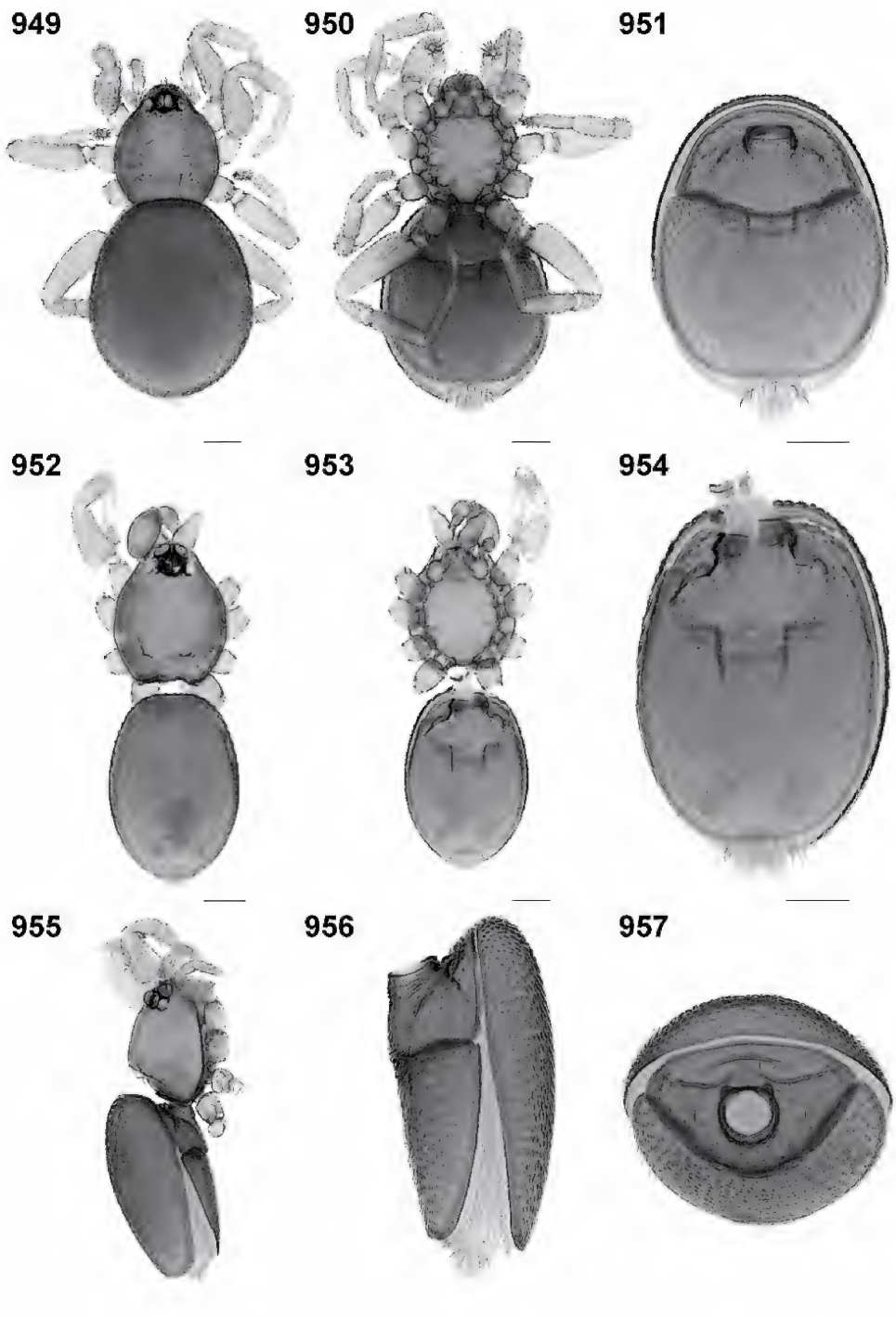
VARIATION: Male: TL: 1.29–1.32; CL: 0.57–0.59; CW: 0.46–0.48; AL: 0.70–0.77; AW: 0.48–0.51.

Female: TL: 1.27–1.28; CL: 0.55–0.73; CW: 0.47–0.49; AL: 0.70–0.91; AW: 0.64–0.67.

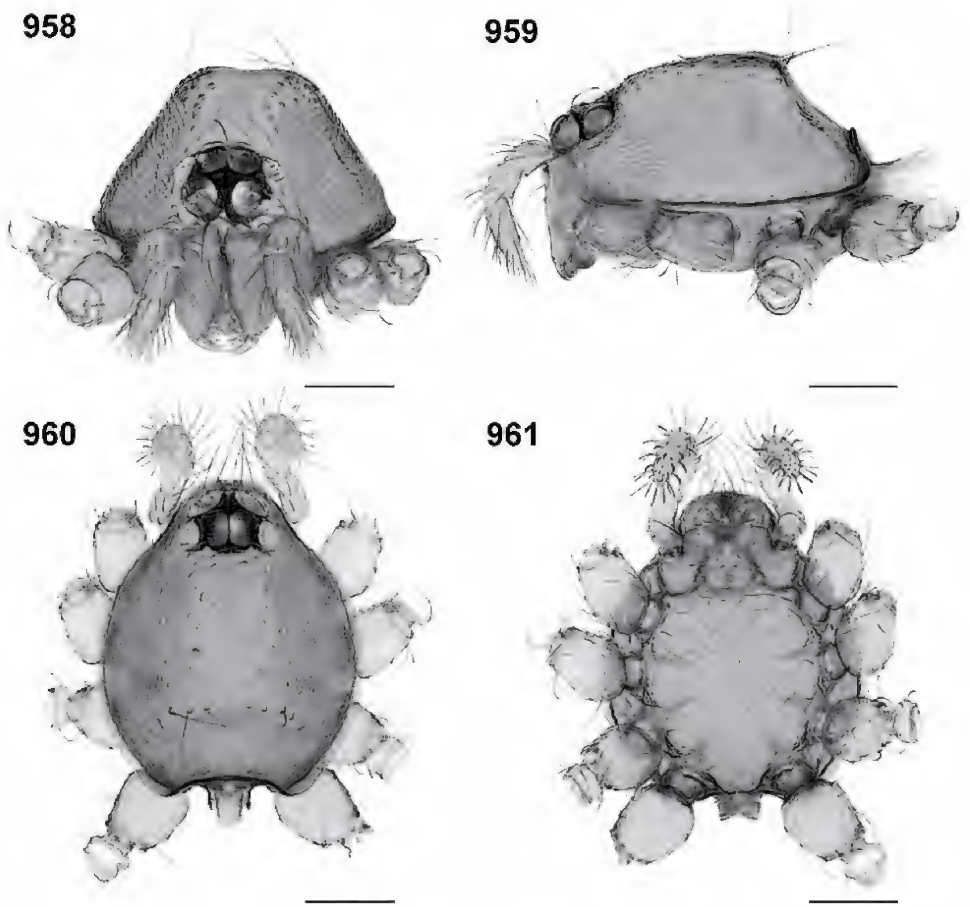
NATURAL HISTORY: *O. tsinjoriaky* was mostly found in very dry spiny forest at low elevations.

DISTRIBUTION: *O. tsinjoriaky* was found in southwestern Madagascar, in the province of Toliara (Forêt de Tsinjoriaky, Park National de Tsimanampetsotsa, Ranobe) (map 2).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Toliara:** Park National de Tsimanampetsotsa, forêt de Bemanateza, 20.7 km 81° E Efoetse, 23 km 131° SE Beheloka, 23°59′32″S, 43°52′50″E, 90 m, sifted litter



Figs. 949–957. *Opopaea vohibazaha,* n. sp. **949.** Female, habitus, dorsal view. **950.** Habitus, ventral view. **951.** Abdomen, ventral view. **952.** Male, habitus, dorsal view. **953.** Habitus, ventral view. **954.** Abdomen, ventral view. **955.** Habitus, lateral view. **956.** Abdomen, lateral view. **957.** Anterior view. Scale bars: 0.2 mm.



Figs. 958–961. *Opopaea vohibazaha,* n. sp., female. **958.** Carapace, anterior view. **959.** Lateral view. **960.** Dorsal view. **961.** Ventral view. Scale bars: 0.2 mm.

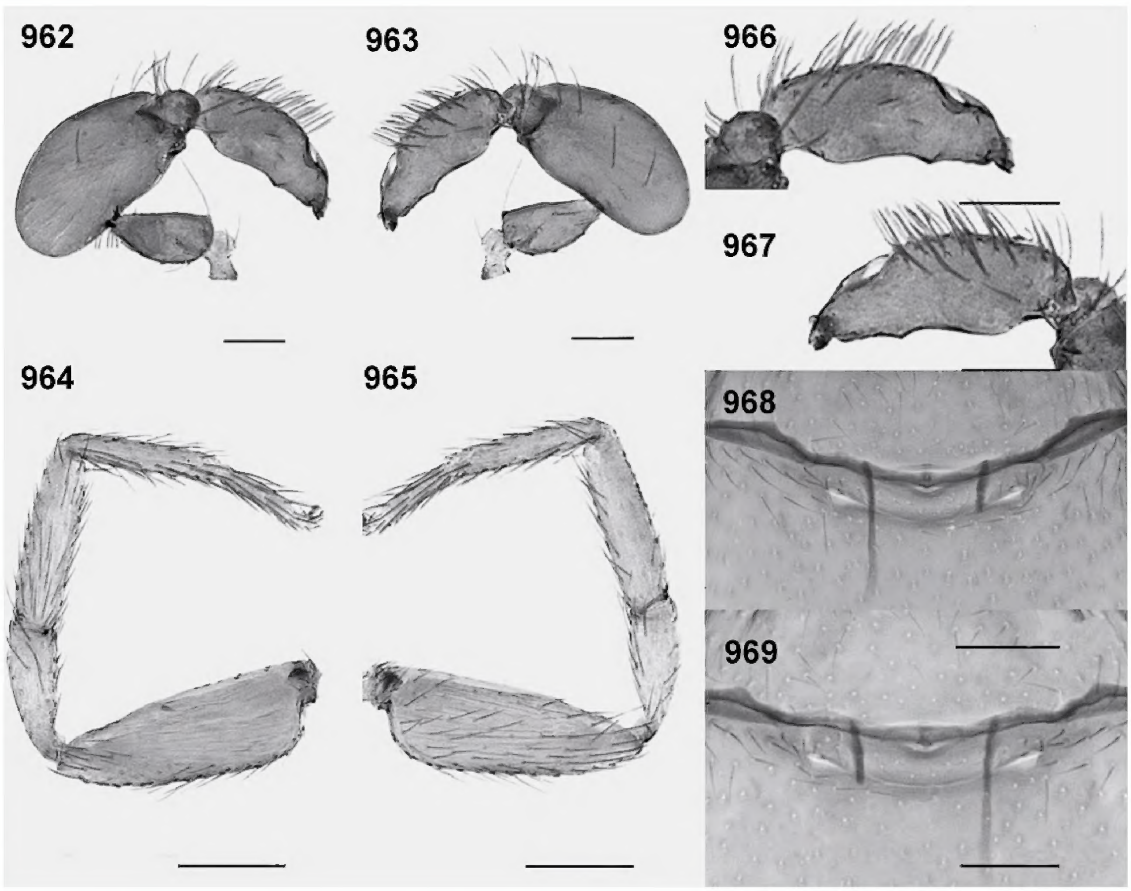
(leaf mold, rotten wood), spiny forest/thicket, 22–26 March 2002, coll. B.L. Fisher et al. (CASC PBI_OON 00034313), 12♂, 23♀. Ranobe, 23°02′22″S, 43°36′37″E, 30 m, sifted litter (leaf mold, rotten wood), spiny forest/thicket, 05–28 January 2003, coll. Frontier Project (CASC PBI_OON 3817), 1♀. Forêt de Tsinjoriaky, 6.2 km 84°E Tsitoha, 22°48′8″S, 43°25′14″E, 70 m, sifted litter (leaf mold, rotten wood), spiny forest/thicket, 06–10 March 2002, coll. B.L. Fisher et al. (CASC PBI_OON 3771), 8♂, 20♀.

Opopaea vohibazaha, new species
Figures 946–973; map 5

TYPES: Male holotype and female allotype from Antsiranana: 7.2 km 142° SE Antsiranana (= Diego-Suarez), Montagne des Français, 12.32278°S, 49.33817°E, 180 m. 23–25 February 2001, L.J. Boutin coll. (CASC PBI_OON 35032).

ETYMOLOGY: The species epithet is a name in apposition taken from the type locality "Montagne des Français" translated into Malagasy.

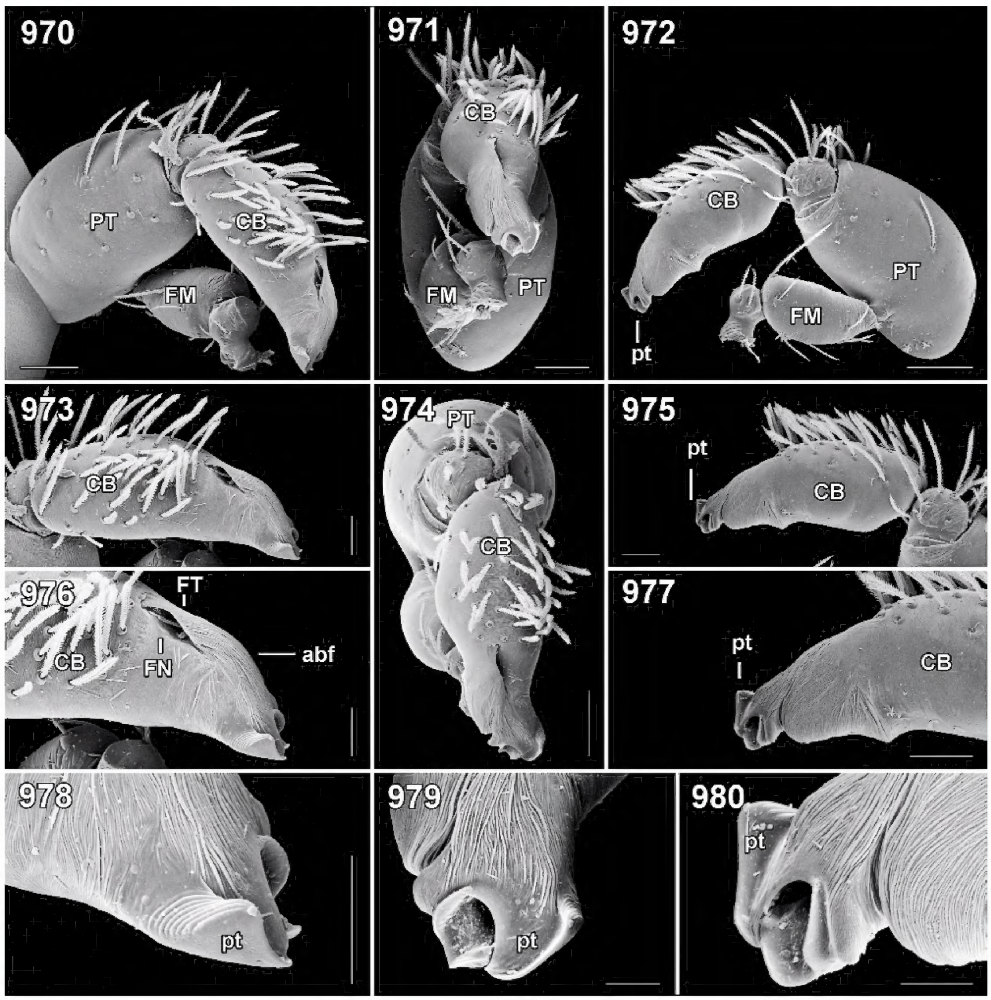
DIAGNOSIS: Males of *O. vohibazaha* can be most easily distinguished from those of other *Opopaea* species by the shape of the cymbiobulbus, which tapers anteriorly with the dorsal margin curved in an arc shape and the posterior margin (ventral) straight with one small and sharp distal protuberance, and by the cymbiobulbus tip having a sclerotized truncated, leaflike extension (figs. 172, 173, 955, 956, 959, 960, 963–973). Females of *O. vohibazaha* can be easily recognized by their very simple epigynum, with a short and



Figs. 962–969. *Opopaea vohibazaha,* n. sp. **962.** Male, palp, prolateral view. **963.** Retrolateral view. **964.** Leg IV, prolateral view. **965.** Retrolateral view. **966.** Male, palp, close up, prolateral view. **967.** Retrolateral view. **968.** Epigynum, ventral view. **969.** Dorsal view. Scale bars: figures 964, 965 = 0.2 mm; others = 0.1 mm.

narrow postgynum depression, and a divided scutal ridge bearing a small round parmula within its median part (figs. 174, 961, 962).

DESCRIPTION: Male (holotype) (PBI_OON 35032). Medium-sized to large species. Total length 1.56. Color: orange. Carapace: pars cephalica elevated posteriorly with one row of two widely separated sets of four denticles, three of which bear long, and thick black needlelike hairs. Carapace anterolateral corners without sclerotized triangular extension. Clypeus low, not rebordered. Chilum absent. Eyes large. ALE largest. ALE oval, PME squared, PLE circular; PME darkened compared to other eyes, posterior eye row straight viewed from above, slightly procurved from front; ALE separated by less than their radius, ALE-PLE separated by less than ALE radius, PME touching throughout most of their length, PLE-PME separated by less than PME radius. Sternum longer than wide with radial furrows between coxae, surface smooth, without pits, shape of posterior part between coxae IV hexagonal, wide, not constricted laterally near the end. Lateral margins between coxae III unmodified, without lumps; setae more or less abundant, evenly distributed, originating from surface, without hair tufts (figs. 951–954). Cymbiobulbus almost as long as the patella. Palpal fenestra more or less circular on prolateral side and more elongated on retrolateral side. Located at one third the length of the palp, fenestra top not raised, continuing anteriorly into an elongated sclerotized area. Palpal femora length about



Figs. 970–980. *Opopaea vohibazaha,* n. sp., male palp. **970.** Prolateral view. **971, 974.** Anterior view. **972.** Retrolateral view. **973, 976.** Close up, prolateral view. **975, 977.** Retrolateral view. **978.** Embolar region, prolateral view. **979.** Dorsal view. **980.** Retrolateral view. Scale bars: figures 970–972, 974 = 30 μm; figures 973, 975 = 20 μm; figures 976–978 = 10 μm; others = 5 μm. Abbreviations: **abf,** area before fenestra; **CB,** cymbiobulbus; **FM,** femur; **FN,** fenestra; **FT,** fenestra top; **PT,** patella; **pt,** palp tip.

two thirds the length of the palpal patella and inserted almost medially to it (figs. 172, 173, 955, 956, 959, 960, 963–973).

Female (allotype) (PBI_OON 35032). Total length 1.72. Orange, abdomen round and not flattened posteriorly. Postgynum ridge thin and sclerotized (figs. 174, 961, 962).

MEASUREMENTS: Male (holotype) (PBI_OON 35032). TL: 1.56; CL: 0.66; CW: 0.53; CH: 0.24; AL: 0.86; AW: 0.57; ALE: 0.09; PME: 0.08; PLE: 0.07; EGW: 0.23; ALE-ALE: 0.03; ALE-PLE: 0.02; PME-PME: 0; PLE-PME: 0; CBL: 0.23; CBW: 0.10; CBL/PTL: 0.88; FI: 0.10.

Female (allotype) (PBI_OON 34407). TL: 1.72; CL: 0.73; CW: 0.60; CH: 0.33; AL: 1.09; AW: 0.88; ALE: 0.10; PME: 0.09; PLE: 0.07; EGW: 0.23; ALE-ALE: 0.02; ALE-PLE: 0.01; PME-PME: 0; PLE-PME: 0; EFL: 0.18; LAL: 0.08; PGI (LAL/EFL): 0.44; PDL/LAL: 0.5; PDW/EFL: 0.38.

VARIATION: Female: TL: 1.72–1.84; CL: 0.73–0.73; CW: 0.60–0.60; AL: 1.09–1.09; AW: 0.81–0.88.

NATURAL HISTORY: *O. vohibazaha* was mostly found in rainforest at 180 m elevation.

DISTRIBUTION: *O. vohibazaha* was found in northern Madagascar, in the province of Antsiranana (Montagne des Français) (map 5).

OTHER MATERIAL EXAMINED: MADAGASCAR: **Antsiranana:** 7.2 km 142° SE Antsiranana (= Diego-Suarez), Montagne des Français, 12.32278°S, 49.33817°E, 180 m. 23–25 February 2001, L.J. Boutin coll. (CASC PBI_OON 35032), 1♀.

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